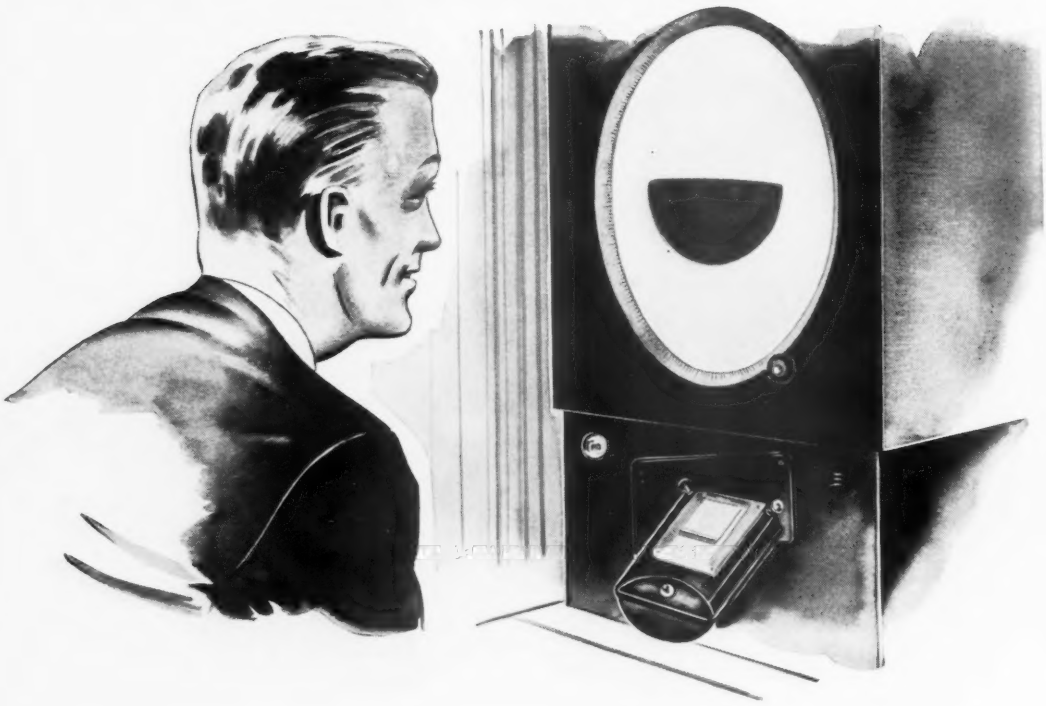
PROPERTY OF
PRINCETON UNIVERSITY LIBRARY
RECEIVED SEP 20 1945

RST

AERONAUTICAL ENGINEERING REVIEW

SEPTEMBER 1945

Take a Precision View



of your *Postwar* Pump...

Before you make your decision on the component parts of your postwar Planes, consider the *vital importance of the pump.*

The pump is the unit that should be considered from a *precision view.* For the pump is the very heart of any product that requires the flow of gasoline, water, alcohol and other fluids. Performance failures due to the adoption of pumps that are *temporarily* good enough for the purpose, can injure your reputation on the entire product.

If you want maximum precision and dependability for unexcelled performance, we invite your inquiry, for we may soon be able to give you pumps of Superfortress quality.

Romec **PUMP COMPANY**

121 ABBE ROAD • ELYRIA • OHIO

AERONAUTICAL ENGINEERING REVIEW

Published Monthly by the Institute of the Aeronautical Sciences, Inc., as a Part of the Services of the Aeronautical Archives

ABC

September, 1945

VOLUME 4 NUMBER 9

Copyright, 1945, by the Institute of the Aeronautical Sciences, Inc.

OFFICERS

President
Charles H. Colvin

Treasurer
Earl D. Osborn

Past-Presidents
J. C. Hunsaker
Charles L. Lawrance
D. W. Douglas
Glenn L. Martin
Clark B. Millikan
T. P. Wright
George W. Lewis
James H. Doolittle
Frank W. Caldwell
Hall L. Hibbard
Hugh L. Dryden
R. H. Fleet

Assistant to the President
George R. Forman

Secretary
Robert R. Dexter

Controller
Joseph J. Maltan

Council
Lester D. Gardner, *Chairman*
P. R. Bassett
Rex B. Beisel
George W. Brady
William K. Ebel
Sherman M. Fairchild
Charles Froesch
R. Paul Harrington
C. S. Jones
Otto E. Kirchner
John C. Leslie
Alfred Marchev
Elmer A. Sperry, Jr.

Vice-Presidents
W. A. M. Burden
Leroy R. Grumman
I. M. Laddon
Arthur E. Raymond

Executive Vice-President
Bennett H. Horchler

SUBSCRIPTION RATES

Aeronautical Engineering Review: United States and possessions, 1 year, $3.00; single copies, $0.30. Foreign countries including Canada (American Currency Rates), 1 year, $3.50; single copies, $0.35.

Journal of the Aeronautical Sciences: Published Quarterly in January, April, July, and October. United States and possessions, 1 year, $7.00; single copies, $2.00. Foreign countries including Canada (American Currency Rates), 1 year, $9.00; single copies, $2.50.

Entered as second-class matter at the Post Office, Easton, Pa., April 29, 1942. Acceptance for mailing at a Special Rate of Postage as provided for in the Act of August 24, 1912.

Publication Office: 20th & Northampton Streets, Easton, Pa.

Editorial Office: 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N. Y.

Notices of change of address should be sent to the Institute at least 30 days prior to actual change of address.

Statements and opinions expressed in the Aeronautical Engineering Review are to be understood as individual expressions and not those of the Institute.

CONTENTS

Cover Illustration

Nose of streamlined nacelle for 7,000-hp. electric fan motor in United Aircraft Corporation's wind tunnel.

Articles

Effect of Recent Research on the Weldability and Control of the Production of Steel Aircraft Tubing . . . . . Arthur J. Williamson 5

Drift Sights . . . . . Fred Wallsteiner 25

The Influence of the Earth's Rotation on Bubble Sextant Readings . . . . . J. J. Green 35

Reviews

Periodicals 57

Government Publications 93

Books 117

The Standard Guide to Private Planes
Your Personal Plane
Science in Progress
Scientific Societies in the United States
Prospects and Problems in Aviation
American Air Navigator

House Organs and Catalogues 125

From the Industry 135

General

Appreciation to Corporate Members 32

Institute News 37

Personnel Opportunities 47

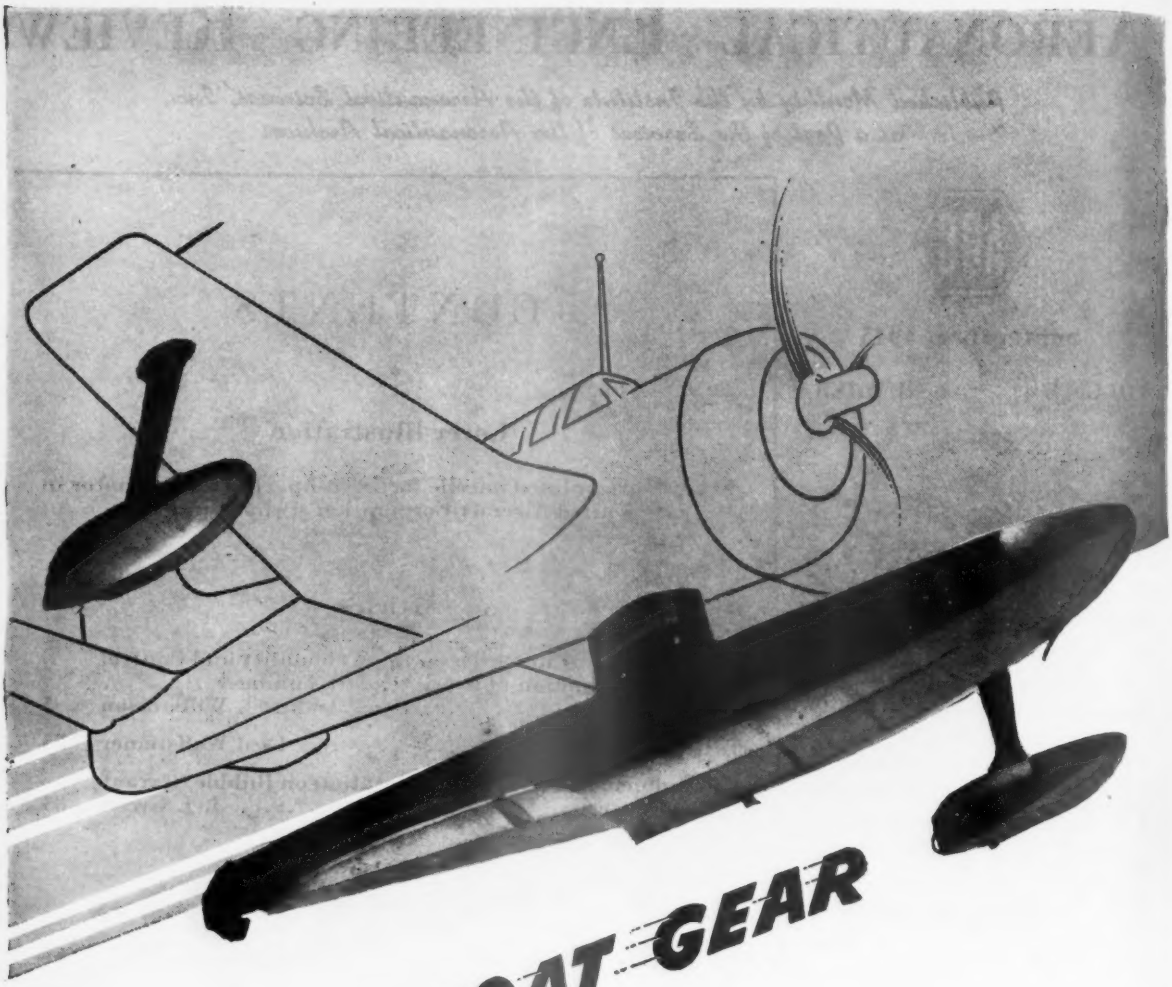
I.A.S. Los Angeles Meeting 53

Index to Advertisers 157

George R. Forman, *Editor* Russell F. Rogers, *Manager*

Harris F. Reeve, *Managing Editor*

Associate Editors: Gail Wadro, Berneice H. Jarck, Edward G. Ingram



EDO FLOAT GEAR

THE LONG and illustrious war record of our naval and military float planes in the Pacific is hailed nowhere with greater satisfaction than at the Edo plant at College Point where so much of the float gear for our warplanes has been produced. Today the Edo organization looks forward to the resumption of civilian flying when its matchless experience of twenty years in building seaplane floats may once more be placed at the disposal of peacetime aviation.

EDO AIRCRAFT CORPORATION
602 Second Street
College Point, L. I., N. Y.

Effect of Recent Research on the Weldability and Control of the Production of Steel Aircraft Tubing

ARTHUR J. WILLIAMSON*

Summerill Tubing Company

Introduction

Two years ago, the Office of Production Research and Development, through the facilities of the Battelle Memorial Institute, initiated a research on the weldability of low-alloy steels. The results of this investigation have been given in a recent paper entitled "Metallurgical Factors of Underbead Cracking" by S. L. Hoyt, C. E. Simms, and H. M. Banta, a Preprint of the American Institute of Mining and Metallurgical Engineers, Technical Publication No. 1847. The present paper is a critical review of the results of this research, and the data herein contained have been taken from this A.I.M.M.E. publication, in addition to the detailed results contained in the final project report.

At the outset of the war, practically all fabricators of metallic materials realized that welding was going to play a big part in the production of matériel for war. The aircraft industry, confronted with the making of 50,000 airplanes per year, was among the first to acknowledge the importance of proper welding. The problem of the training of welders to do the job was also enormous.

Although the fundamentals of welding have been known for a long time, it is not believed that they have been appreciated by the men who do the welding as much as they should have been. This is perhaps because of lack of education. Plant management has also been reluctant to adopt safe welding practice, particularly if superficially it did not appear too important. Seemingly, postheating, preheating, and controlled cooling are looked upon as unnecessary expenditures. It is extremely difficult, in the welding of other than low-carbon steels, to make the welder fully realize the importance of the metallurgical considerations involved when he begins to heat metal with an oxyacetylene flame or when he strikes an arc.

Although it may be disputed, the welding of low-carbon steel is relatively simple when compared to the welding of the low-alloy, high-strength steels

Received December 28, 1944. To have been presented at the I.A.S. Thirteenth Annual Meeting, which was canceled to cooperate with a Government appeal (January, 1945) to refrain from holding conventions and meetings.

* Chief Metallurgist. Also Chairman of a Project Committee, appointed by the War Metallurgy Committee, to act in an advisory capacity to the Office of Production Research and Development—Project 13.

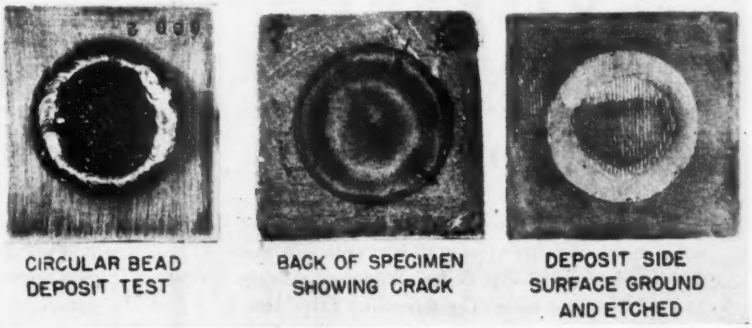


Fig. 1. Circular bead deposit test specimens. The first two photographs above show front and back views of weld test specimens from the crack sensitive steel 581. Note the crack as located by the arrows in the back view. These cracks were not visible on the bead side but occurred on the back side of each specimen In each case the crack was located in the same relative position with respect to the starting point of the bead, roughly between the limits of 90 and 200°. Numerous fine cracks were found in the bead side of specimens from both 581 and 557 samples after surface grinding and etching. However, these cracks are much too fine to be seen in the third view shown above. (Taken from Project NRC 514 W.P.B.)

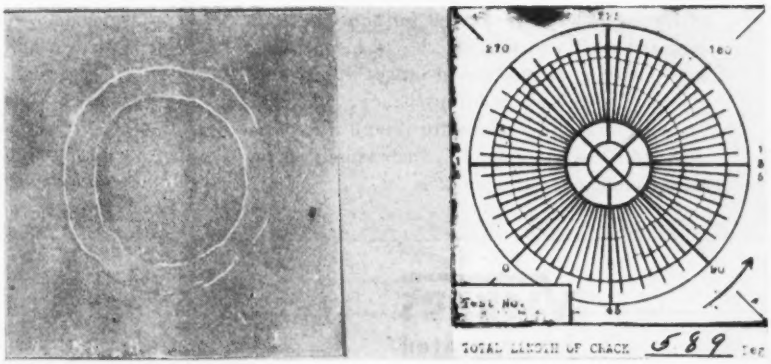
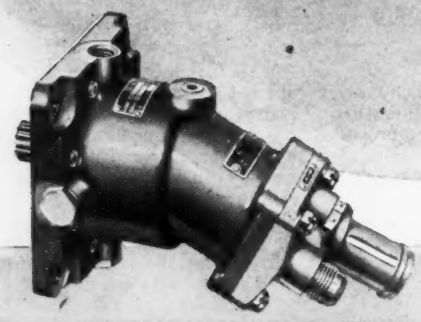


Fig. 2. (*Left*) Crack-sensitivity specimen after Magnafluxing. (*Right*) Record card with scotch tape transfer of cracks. (Taken from Project NRC 514 W.P.B.)

ANSWERING THE QUESTION:

"Should I Use Constant Volume or Variable Volume Aircraft Pumps?"

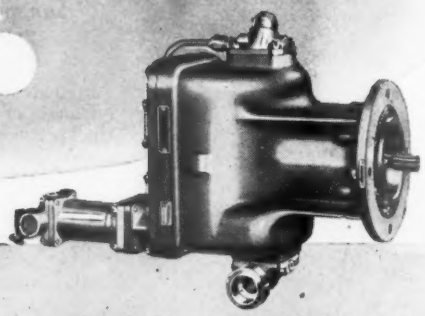


WHEN TO USE

VICKERS CONSTANT VOLUME

PISTON TYPE PUMPS

This pump requires an accumulator and unloading valve in the majority of aircraft hydraulic circuits. The fixed-stroke pistons deliver fluid continuously to the unloading valve. The unloading valve automatically opens when the accumulator has received and stored its maximum volume of fluid at system pressure; the pump then operates at no pressure by returning oil directly to reservoir. When the accumulator pressure drops to a predetermined minimum, the unloading valve automatically closes and diverts the oil to charge the accumulator. This constant volume pump is recommended when hydraulic power is required for short periods during take-off and landing . . . when operating flaps, landing gear and power brakes. It also supplies any small demand during flight . . . like cowl flap actuators. And it takes care of normal requirements while on the ground . . . including parking brakes and cargo door operation.



WHEN TO USE

VICKERS VARIABLE VOLUME

PISTON TYPE PUMPS

This pump automatically delivers the volume of fluid required by the hydraulic system. When the requirement decreases, the stroke of the pistons is automatically shortened; when more volume is needed, the piston stroke is automatically lengthened. There is no inlet restriction to cause cavitation. An excess of fluid is *never* pumped. The pump *maintains* full pressure in the system with minimum horsepower. An integral pressure control device automatically and continuously maintains the desired pressure independent of varying volume demand and of engine speed. This variable volume pump is recommended when hydraulic power is used continuously during flight . . . as for power boost flight control, gun turret drive, and cabin supercharger drive.

Vickers Engineers will gladly discuss with you the relative merits of these pumps for your individual requirements.

VICKERS
Incorporated
1414 OAKMAN BOULEVARD
DETROIT 32, MICHIGAN

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

with carbon contents of approximately 0.30 per cent and over.

There has been much written in the literature during the past 20 years, both in this country and abroad, as to the causes and prevention of the so-called "welding crack" in the alloy steels noted above. The problem has been particularly troublesome in the aircraft industry where these low-alloy, high-strength steels (e.g., X4130), especially sheet and tubing of relatively light gages, are used.

When the Project Committee was appointed by the O.P.R.D., one of the problems with which it was presented was "weldability." There were several phases of this problem; for example, the Ordnance Department of the U.S. Army had some fabrication difficulties in the making of gun mounts, tank parts, etc. The aircraft industry had many problems in the manufacture of engine mounts, fuselages for training planes (which are practically all tubing construction), and landing gear struts, all of which are made from tubing welded assemblies.

With these problems in mind, one project was set up on welding called "Investigation of the Welding Quality of Low-Alloy High Strength Steels" in which the writer was particularly interested and took an active part. This work was conducted at a research institution where this problem was approached with a fundamental treatment; although not new, it was attacked with a new conception and method of explanation. Certain factors that appeared to be mysteries were explained by the application of fundamentals of physical chemistry and metallurgy. Only arc-welding effects were studied.

The details of this work should be of interest to everyone in welding, and it is hoped that the points covered will not be too theoretical so that even the man who has only a little knowledge of chemistry and metallurgy will be able to understand and appreciate these results.

Standard Sample—Cracking Measurements

The first work of the committee assigned to solve the problem was to procure, from the field, samples of materials that appeared to have given trouble in welding. It was extremely fortunate for the committee to find two steels, submitted by an interested party, one of which seemed always to produce cracking in arc welding, and the other, under the same conditions, did not. Having the advantage of choice samples and sufficient quantities with which to experiment, the committee was for a long time determining a type of laboratory test to use which could reproduce similar results every time the sample or test was repeated. The committee finally decided upon the use of a 2 in. square plate, 1/8 in. thick. Upon this plate, under controlled conditions, a welding bead was deposited in a circle of approximately 1 in. in diameter. The specimens were from two different heats of

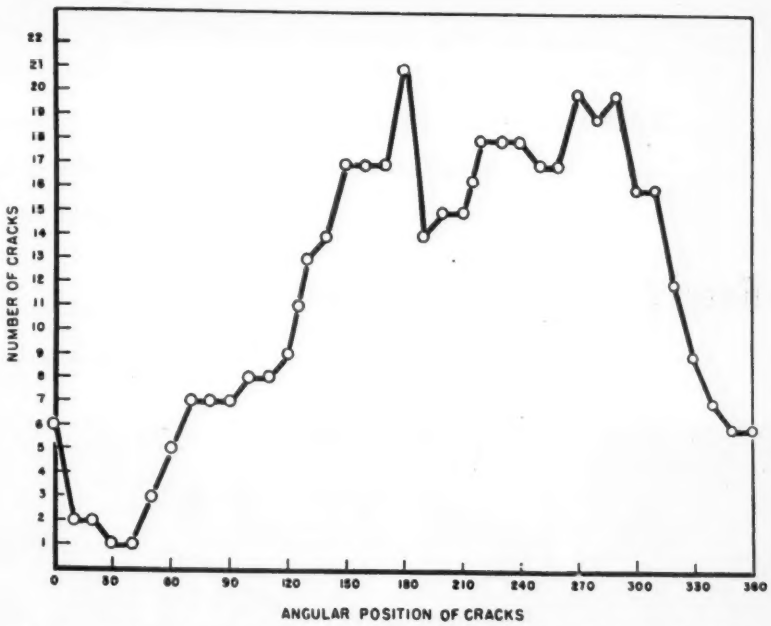


Fig. 3. This frequency curve shows that the occurrence of cracks on the back side of the test specimen is at a minimum between 30 and 40° from the start of the bead. (Taken from Project NRC 514 W.P.B.)

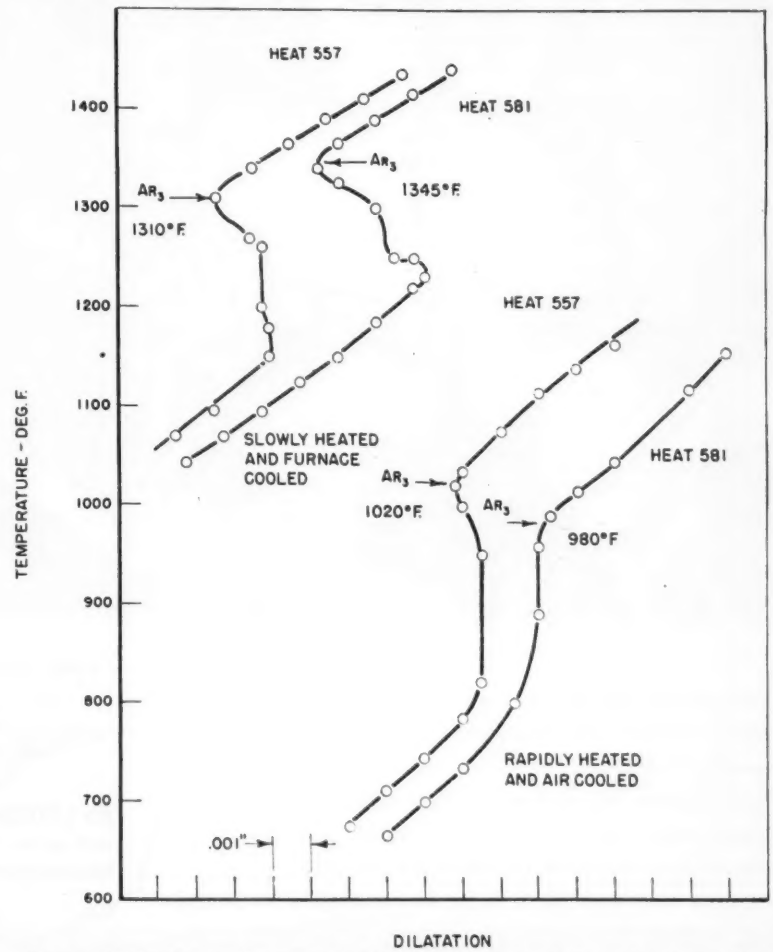


Fig. 4. Dilatometer cooling curves, for both the slow and rapid thermal cycles, of Steels 557 and 581. (Taken from Tech. Pub. 1847 A.I.M.M.E.)

JUST BACK from a successful interception of Jap planes, these fighter pilots relax in the ready room of a first-line aircraft carrier in the South Pacific. Theirs is a destination beyond Tokio. These are the faces you'll see at the controls of airliners and air transports; behind airlines desks; in the executive office of aircraft plants. These skilled airmen are ready NOW for tomorrow. Ready with a background of the most terrible schooling, but the finest training and flight experience a man can get . . . *action in war!*

Ready . . . for Tomorrow, too

***ESSO AVIATION PRODUCTS** are ready, too! Esso Univis Hydraulic Oils, for example, have ridden with these boys from the freezing North Atlantic to the heat-heavy South Pacific. These advanced high altitude oils have minimum viscosity change under widest temperature variations, plus unusually good stability and special rust-preventive qualities.*

Proved and proved again in the furious trials of air combat, Esso Aviation Products are products you can depend *on to meet the accelerated demands of future aviation.*

YOU CAN DEPEND ON

ESSO

AVIATION PRODUCTS

SOLD IN THE 25 STATES INDICATED

X4130 and were designated as heat 557 (good) and heat 581 (bad). Fig. 1 shows the type of specimen and bead deposit. The specimen was polished on the back side and etched to show the degree of cracking on the underside of the plate. *It was important to note that sometimes the cracking occurred shortly after welding, and in other cases the cracking took several hours to many days before cracking was made evident.*

Fig. 2 shows more clearly the type of cracking on the underside of the bead deposit after magnetic inspection. This figure also shows the manner of making records as to the degree of cracking on these specimens measured in circular degrees.

Fig. 3 shows the frequency of the occurrences of the cracks with respect to the start of the bead. One will note the frequency of the cracks approximately 180° to 300° from the starting point of the bead. One will also note the low number of cracks at a position of 30° from the start. It is reasonable to believe that the absence of cracks in this 30° region is caused by the heat input of the arc when the end of the weld bead is approached, and the closing of the circle results in some tempering of the previously deposited bead.

Dilatometer Studies

After considerable study and looking for a solution for the reasons for the repeated cracking of one steel as opposed to the other, a thorough study was made of the steel-making practice, hardenability, chemical analysis, metallurgical examination, etc. It appeared that there were not sufficient differences between the two steels except in the metallurgical structure. It was noted that the steel that contained the largest carbide particle size resulted in less cracking than one with a finer carbide particle. Substantiating this evidence, cooling curves were run on a dilatometer and are shown in Fig. 4. One will note that the normal manner of running dilatometer studies showed the good steel to have a lower A_{R3} point than the one that produced cracking. This could not be reconciled with the carbide size and rate of solution. It was then conceived that dilatometer studies would have to be made to simulate those conditions that occur in arc welding—that is, extremely rapid heating and relatively fast cooling. This resulted in incomplete carbide solution, thereby forming a higher temperature and lower carbon austenite. A method was devised to accomplish this, and, again referring to Fig. 4, one will note that the A_{R3} points are now reversed for the two steels, thus substantiating the metallurgical findings.

Further experimenting revealed that the steel that produced cracking in the as-received condition could be made insensitive to cracking by certain heat-treatments, etc.

Fig. 5 shows the typical heating and cooling curve in the rapid dilatometer study.

Fig. 6 shows another set of dilatometer curves for two other steels with di-

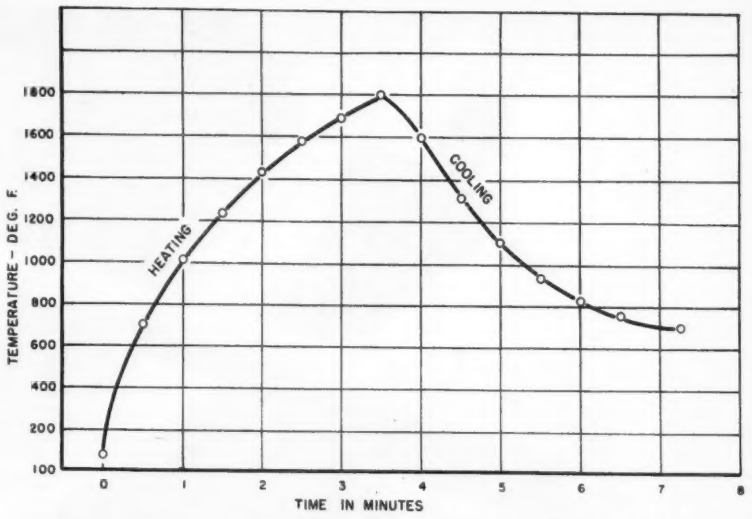


Fig. 5. Typical time-temperature heating and cooling cycle for the rapid dilatometer test. (Taken from Tech. Pub. 1847 A.I.M.M.E.)

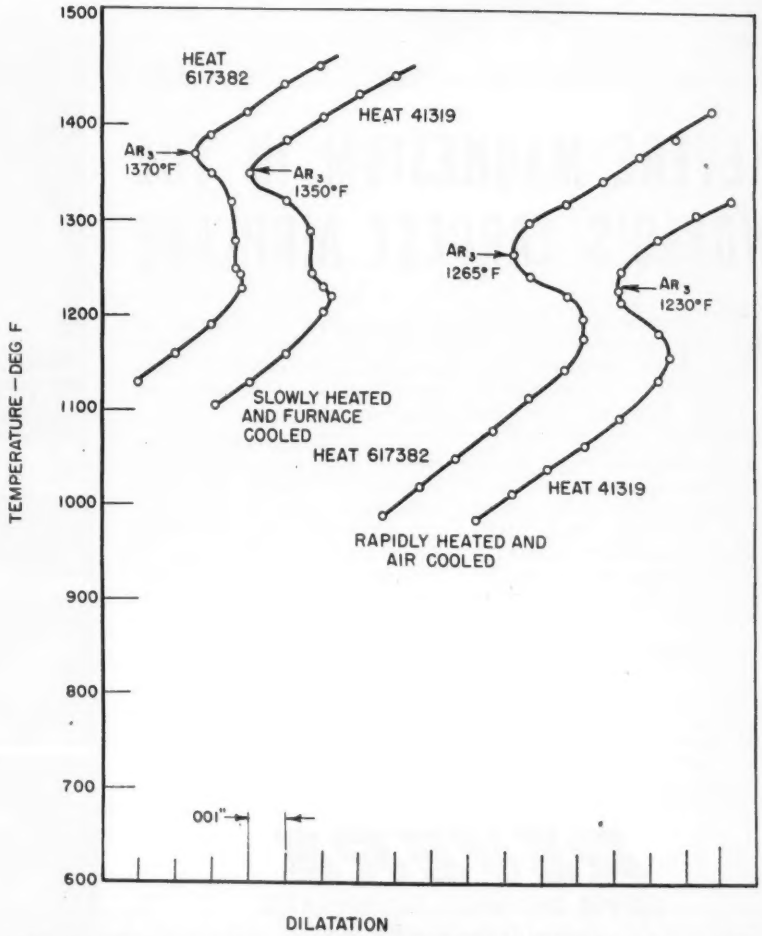


Fig. 6. Dilatometer cooling curves for Steels 617382 and 41319. Note the great difference in the dilatometer curves, depending upon prior heat-treatment. (Taken from Project NRC 514 W.P.B.)

A fleet of these great land-based clippers has been ordered by Pan American World Airways. Carrying a payload of 50,000 pounds made up of 204 passengers and 15,300 pounds of baggage, mail and express, they will have a non-stop range of 4200 miles. Flight time from New York to London will be just over nine hours.

REVERE MAGNESIUM IN THE WORLD'S LARGEST AIRPLANE

THE great new Model 37 Trans-Ocean Transports recently announced by Consolidated Vultee are designed to carry more payload on longer flights than any other airplanes ever before proposed.

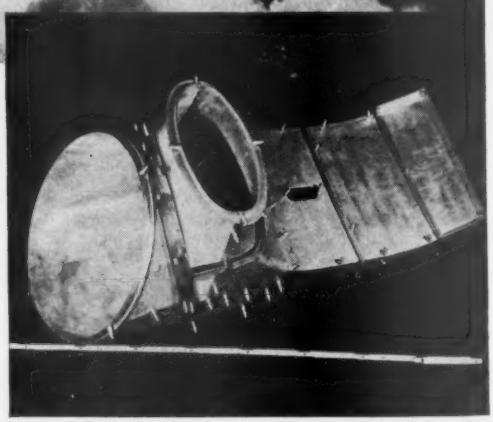
In the hangar where the first of these giants is being assembled is a sign reading: "Weigh Everything Before Placing on Plane." How seriously this principle has been followed by the engineers is shown by their extensive use of Revere magnesium throughout this airplane.

Revere magnesium alloy sheet is used in the skin, in air ducts, in the thermal anti-icing system of special design, and in a multitude of other parts. Revere magnesium extruded shapes and forgings also help to give strength with less weight to important components of this huge transport. Gasoline, oil, and other lines are made of Revere aluminum tubing.

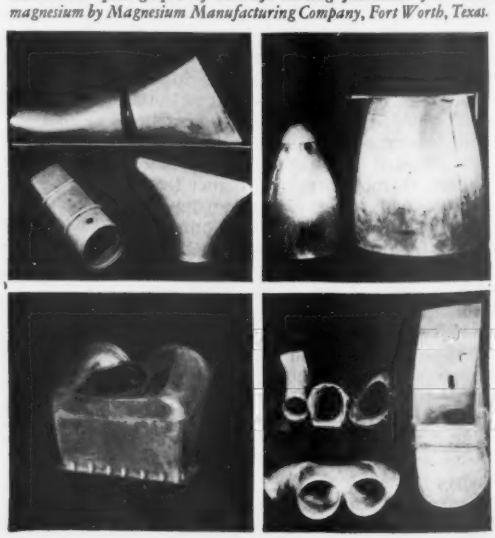
To those who have felt that fabrication of magnesium units presents unfamiliar problems, the sheet metal parts shown on this page may prove especially interesting. Revere magnesium sheet may be formed, stamped, bent, deep drawn, spun, and welded by techniques known and used by the aircraft industry and many others.

For all the facts on how magnesium can save weight in your products, call Revere. A Revere Technical Advisor will gladly give you detailed information and advice.

Listen to The Human Adventure *on the Mutual Network every Wednesday evening, 10 to 10:30 p.m., EWT*



Unretouched photographs of aircraft ducting fabricated from sheet magnesium by Magnesium Manufacturing Company, Fort Worth, Texas.



REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

Executive Offices: **230 Park Avenue, New York 17, N. Y.**

Sales Offices in principal cities.

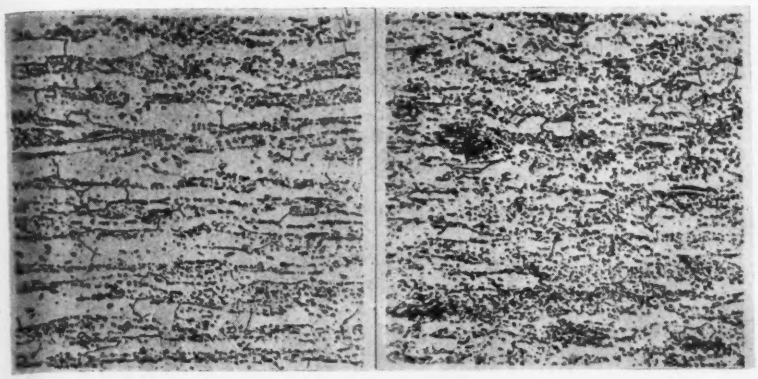


Fig. 7. (*Left*) Steel 617382. Insensitive. (*Right*) Steel 41319. Crack Sensitive. Microstructures of the 0.065-in. gage steels. Longitudinal sections etched in Nital. In the above two steels the carbide particles are smaller and better distributed in the crack-sensitive Steel 41319 than in the companion Steel 617382. (Taken from Project NRC 514 W.P.B.)

vergent cracking tendencies, showing the great differences in the A_{R3} points with different methods of heating.

Statistical Data

After considerable thought and findings it became evident that some standard method for indicating the crack sensitivity of a steel should be evolved. A statistical expert worked out a method whereby he assigned a value of 1.00 to the best steel originally found in this investigation, and then, using the cracked measurement heretofore described, he was able to assign definite values to any steel under study with respect to the value 1.00. Thus, there was a method for rating crack sensitivity, and, as the number became less than 1, it indicated more crack sensitiveness. For example, if a steel had a crack sensitivity of 1.10, it meant that it was not as prone to crack in welding as one with a rating of 0.90. This reversal of figures may appear inconsistent and confusing at times; however, it is important to fix this in one's mind for a study of curves and figures in this report.

Metallographic Studies

Fig. 7 shows the spheroidal carbide structure in two steels, one being crack sensitive and the other being insensitive. These were studied in light gages (0.065 in. gage). One will note that the insensitive steel shows coarser carbide particles that are not too well distributed as compared to the crack-sensitive steel showing a fine carbide, well distributed. In this latter case, the normal welding cycle would result in almost complete solution of all carbides, resulting in a higher hardness martensite.

Fig. 8 shows the effect of normalizing on steels 557 and 581 with regard to the A_{R3} points. Although there do not appear to be any differences in the A_{R3} points, in the normalized conditions, there is a decided difference in the spheroidized condition. It is believed this is a point to be remembered for later emphasis.

In Fig. 9 one will note the differences in weld-hardening on normalized and on spheroidized specimens. The hardness is appreciably greater in the normalized condition and thus is a confirmation of previous findings.

Fig. 10 shows the martensitic structure in the hard zones of the weld of steel 557 in the spheroidal and in the normalized conditions. It is to be noted that there are islands of free carbide remaining in the microstructure in the spheroidized steel, showing that incomplete solution of previously existing carbides is present. There are no such islands in the normalized condition. Thus, there is less effective carbon in the martensite resulting from the spheroidal steel and, consequently, a lower hardness.

Effect of Aluminum on Steel-Making Practice

At this point the committee realized that a lot more work was necessary and it was decided to look into steel-making practice as a possible control for weld cracking. It is known that the use of aluminum promotes lower hardenability presumably by increasing abnormality and by causing formation of more stable carbides. An induction heat of steel was made to which were added varying amounts of aluminum. The first sample contained no aluminum, the second $1^1/_2$ lbs. of aluminum, the third $1^1/_2$ lbs. of aluminum plus 9 lbs. of titanium per ton. The cooling curves for these three samples are shown in Fig. 11. One will note that the A_{R3} points in the steel to which aluminum is added are considerably higher than the one in which there is no aluminum content.

Fig. 12 shows the hardenability curves for these same three samples, and one will note the little difference between the first two curves but a considerable drop in hardenability with $1^1/_2$ lbs. of aluminum plus 9 lbs. of titanium per ton. Fig. 13 shows the stress-strain curves for normalized, and normalized and drawn samples of these aluminum- and titanium-treated steels. These stress-strain curves bear out the hardenability curves shown in Fig. 12.

It was interesting to note that on these three sample lots there was a decided difference in the cracking tendency

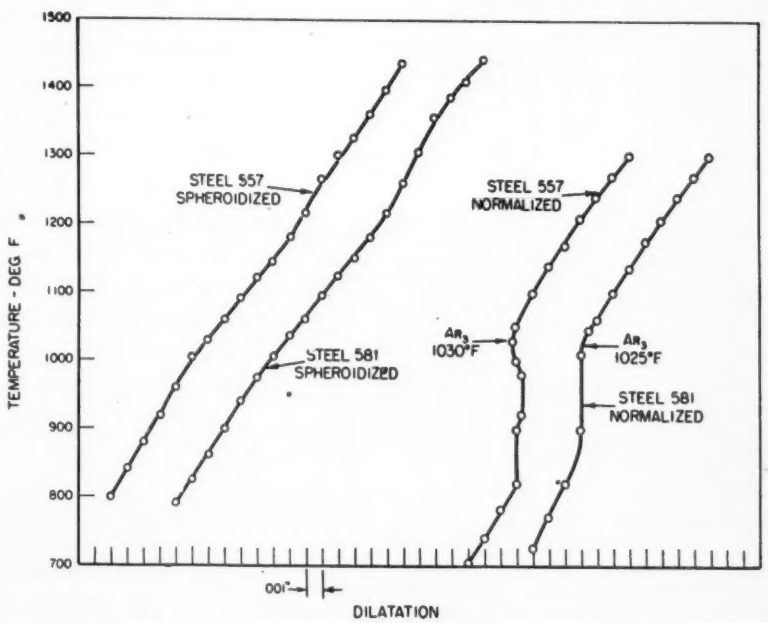
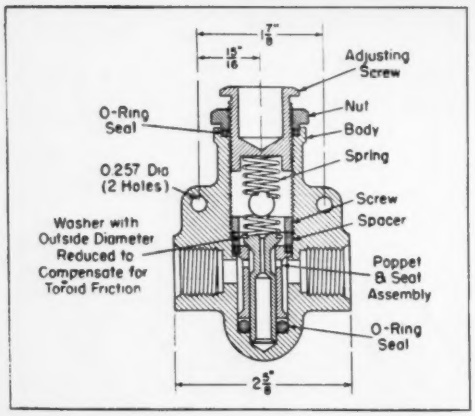
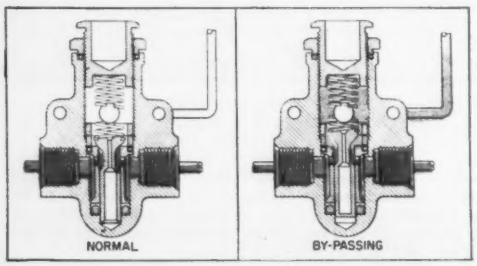


Fig. 8. Dilatometer cooling curves. The above cooling curves show the effect that structure has upon the response of the steels to rapid heating immediately followed by air cooling. Note the spheroidizing treatment has eliminated any evidence of the A_{R3} and A_{R1} points which are obvious in the case of the normalized steels. It is of interest to note both steels showed similar temperature-dilation characteristics after having received the same thermal treatment. (Taken from Project NRC 514 W.P.B.)



As with all Electrol products, simplicity in design is an outstanding feature of this relief valve that meets AN standards and tests. Valve body is cast aluminum. Poppet valve is spring-loaded, and cracking pressure is easily adjustable. Either ¾-16 port can be used as pressure inlet. Outlet port is ¾-16. Operating pressure is 1,500 lb. per sq. in., cracking pressure 1,750 lbs. per sq. in., proof pressure 2,250 lb. per sq. in. Overall height is 4 in., width is 2⅝ in. Total weight is 8½ oz.

Sketches below show valve in operation. At left, system pressure is less than valve setting. Under this condition, fluid passes directly through valve. At right is shown valve operation under excessive pressure conditions. The spring-loaded poppet is unseated, allowing enough fluid to by-pass through the valve to the return line, thus reducing system pressure to a safe value.



VITALLY important to any hydraulic system, Electrol's Relief Valve provides protection by limiting circuit pressure to a safe, pre-set maximum operating value. If pressure build-up occurs, this lightweight, easily installed valve instantly functions, returning fluid to the reservoir thus quickly reducing the pressure in the circuit, and safeguarding operating parts. Although not intended to replace the unloader, the Electrol Relief Valve should be used to protect control circuits, whether on personal, cargo or transport plane.

Standard models, weighing only 8½ oz., operate at 1,500 lbs. per sq. in., relieve at 1,750 lbs. per sq. in. pressure. Dimensions are held to a minimum: 4 in. in height, and 2⅝ in. in width. Manufacture conforms to Electrol high-quality standards and first cost is low. When developing your hydraulic control circuit, investigate Electrol products first. Engineering help is available. Write ELECTROL INCORPORATED, KINGSTON, N. Y.

ELECTROL
HYDRAULICS
ELECTROL INCORPORATED · KINGSTON, N. Y.

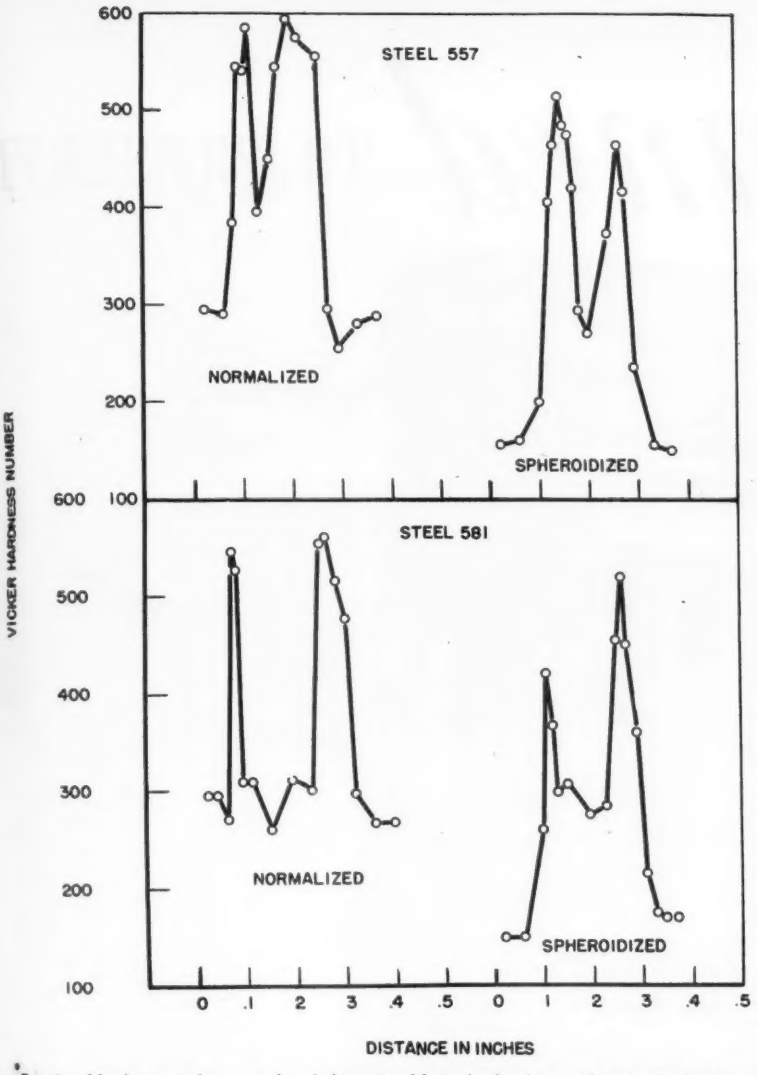


Fig. 9. Hardness study across bead deposit. Note the hardness values in the hardened zone for normalized and for spheroidized conditions for two steels. (Taken from Project NRC 514 W.P.B.)

between the steel with no aluminum and that with aluminum and aluminum-titanium. The one that contained no aluminum cracked considerably.

Fig. 14 shows the photomicrographs for the steel containing no aluminum and that containing $1^1/_2$ lbs. per ton. One will note the decided difference in the particle size and distribution of the spheroidized carbides. This ties in with the findings of the early part of this report.

Fig. 15 shows the same two steels after normalizing. It is to be noted that the steel containing no aluminum shows a typical normalized well-defined structure, whereas the steel containing $1^1/_2$ lbs. aluminum does not show this type of structure but shows more free ferrite and agglomerated carbon areas. This condition is what one would normally expect to find based on the other data.

On another set of samples with six varying aluminum contents it was found that the crack sensitivity index increased with increasing aluminum content.

Aluminum Versus Cracking Effect of Sulphur

Further studies were made with aluminum and the combination of aluminum and sulphur on crack sensitivity. Sulphur is known to have a grain-refining effect and some effect on abnormality. Also the effect of surface pinholes in the welding bead was observed and correlated with aluminum and sulphur combinations. In all cases, the aluminum is shown as the acid soluble.

Fig. 16 depicts the relationship between crack sensitivity and aluminum content and also the effect of heat-treatment on crack sensitivity. One will note that on the hot-rolled and normalized specimens there was no change in the crack sensitivity for the steels studied. However, when annealed to produce the proper carbide condition and then normalized, the crack sensitivity index increased, thus showing a lesser tendency to crack with increasing aluminum content.

Fig. 17 shows the effect of a combination of aluminum and sulphur on crack sensitivity. For the values indicated the higher the aluminum content with the same sulphur content, the greater the possibility for resistance to cracking. However, weld porosity increased as the combination of sulphur and aluminum increased; this is shown in Fig. 18. The surface pinhole effect on the weld bead is also shown in Fig. 19.

Cracking of NE Steels

In order to determine the effect of titanium and carbide size on another steel, samples of NE 8635 steel were produced, and one will note in Fig. 20 that the effect of both titanium and various sizes of carbides have decided effects upon the A_{R3} temperatures. It was also found that the results of this particular study confirmed the results

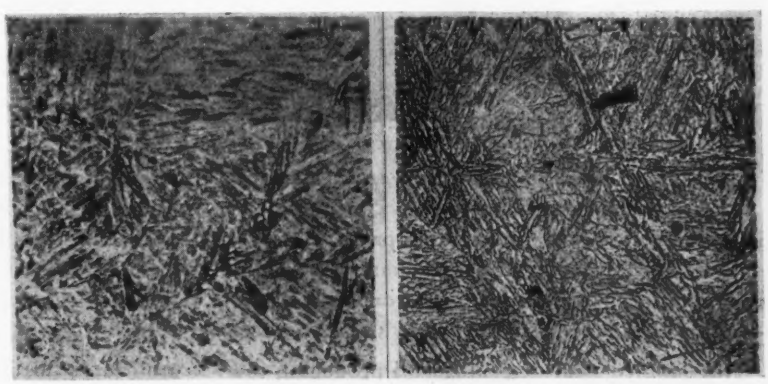


Fig. 10. (*Left*) Hard zone in spheroidized Steel 557. (*Right*) Hard zone in normalized Steel 557. Structures of hard zones at approximately 1000X. The above photographs show the hard structures found in the heat-affected zones of circular bead crack sensitivity test specimens. The above specimens were the same as used for the hardness studies shown in Fig. 22. Both pictures were made 180° from the point where the bead was started. Relatively large carbides will be noted in the spheroidized specimen. Undissolved carbides were not found in the normalized specimen. (Taken from Project NRC 514 W.P.B.)

Canned TO PRESERVE

Buy More War Bonds and Stamps

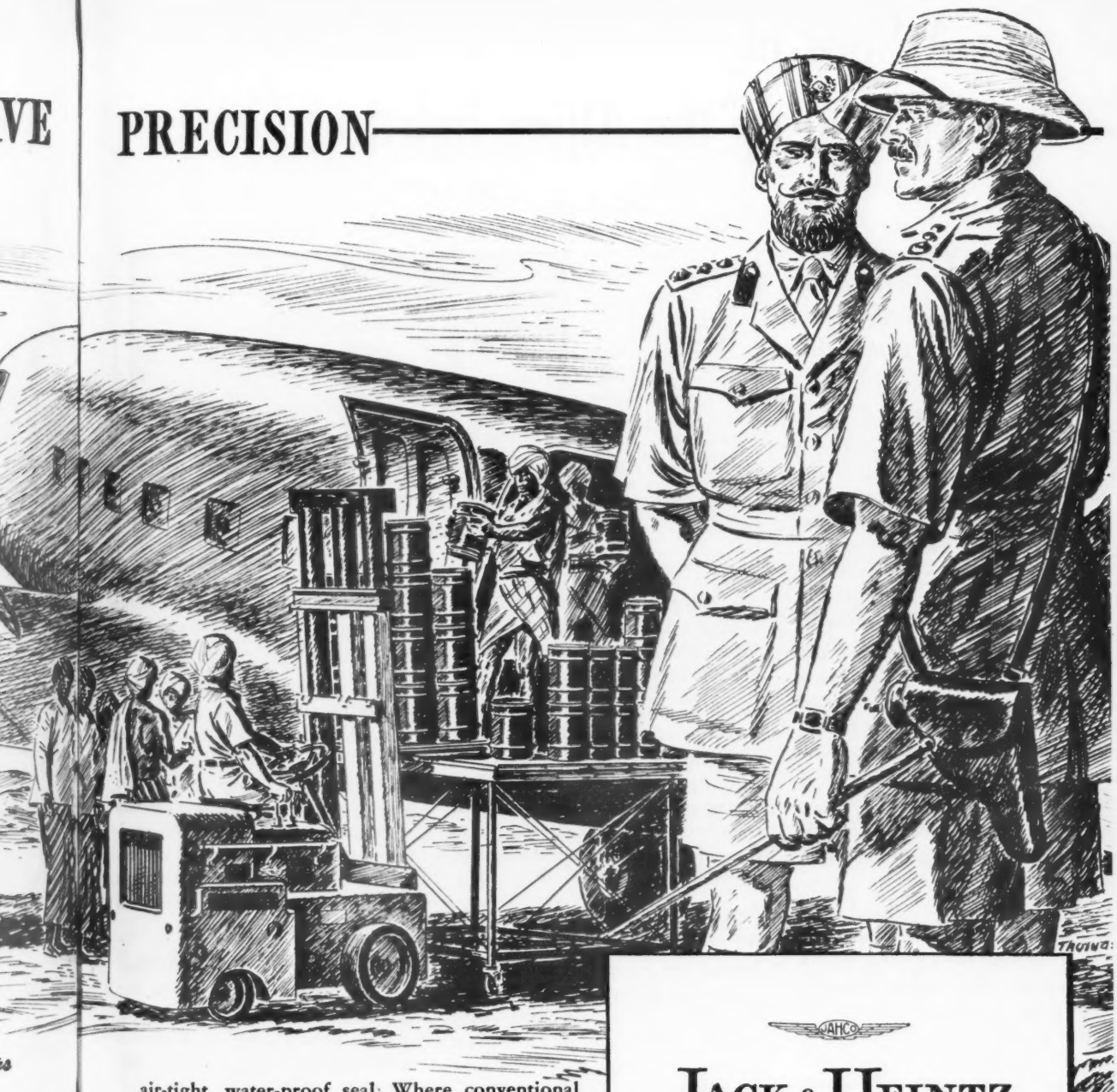
ERROR of a ten thousandth of an inch in the directional gyro might throw a plane far off its course—lose it and all its occupants. Yet such delicate and precise instruments must make long, rough journeys to a war half way around the world—and wait months perhaps before seeing service.

Not satisfied with designing and producing the finest of aircraft equipment, Jack & Heintz engineers were determined to protect it from dirt, dust, moisture, shock—any factor that might destroy its fine accuracy. Working with the Packaging Container Division and the Engineering Division of the Air Technical Service Command, they developed a revolutionary new means of packaging—literally "canning"—to preserve precision.

Precision instruments, starters and generators are floated in rubber-impregnated hair cushion or pulp castings in the can. Silica gel is included to absorb all inside moisture. Then a special J. & H.-developed machine clinches the cover to form an

Jack & Heintz Inc., Cleveland, Ohio, manufacturers of aircraft engine starters, generators,

PRECISION



air-tight, water-proof seal. Where conventional packing was good for six months, Jack & Heintz canning protects for a minimum of two years . . . in steaming jungles as well as in sub-zero cold.

This idea, like hundreds of other Jack & Heintz methods, has excellent peacetime applications—export marketing, for example. In the meantime, it will be used to guarantee delivery to our fighting men of all the precision, performance and long life built into vital aircraft equipment by Jack & Heintz.

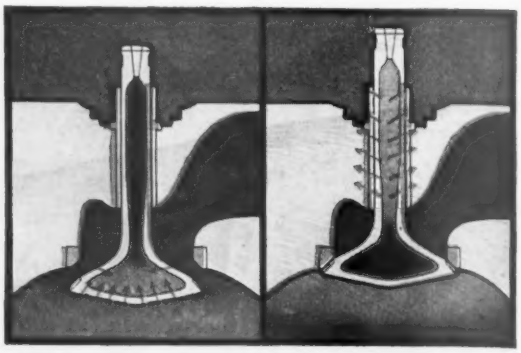
JAHCO

JACK & HEINTZ
Incorporated

gyro pilots, gyro flight instruments, magnetos, motors.

A Shot of *Metallic Sodium* that "souped up" the Allies fighting power

How Eaton pioneering in Sodium-Cooled Valves helped to unleash terrific fighting power in the air, on land and at sea!



As the valve head absorbs the heat of combustion (left hand view), the temperature heats and melts the sodium in the head. The valve motion throws the sodium violently into the valve stem (right hand view). Here the heat of the sodium is transferred to the valve guide, the cylinder and on to the cooling system.

METALLIC SODIUM isn't a precious metal, but—when it was liquefied and sealed in the hollow core of an exhaust valve after World War I, the results were priceless. It released a tremendous flood of pent-up power—the precious power we needed to fight and win two full-scale wars simultaneously.

That research discovery was the starting point for today's 3500-mile bombing runs to Tokyo, for the power that hurls PT boats through the water at 70-mile-an-hour speed, for the swift, knockout punch of huge, armored tanks.

Yes, that little self-cooled exhaust valve did make a big difference in war strategy.

One reason why airplanes and tanks were of limited value in World War I was because the exhaust valves burned out after a few hours in high-powered engines. Ordinary valves were a brake on their speed, range and endurance. And war officials in the United States and England were aware of the dire need of a self-cooling valve. But all their experiments with mercury- and water-coolants had been unsuccessful.

Then, an alert civilian engineer, named S. D. Heron, made a discovery. While working on a self-cooled valve with the U. S. Army Air Corps at McCook Field, he noticed that the salt solutions used in heat treating readily wet the metal pots. That was the clue he needed.

He filled a hollow-stem valve with a mixture of salts and tested it under such engine conditions as violent detonation and pre-ignition. When an uncooled valve would have failed completely, the salt-cooled valve showed little effect from this terrific punishment.

But, where does Eaton come into the picture?

Behind the scenes, all during this pioneering period, Eaton's Wilcox-Rich Division worked closely with Inventor Heron, and in 1926 it was licensed to manufacture the new salt-cooled valve. Then, through extensive Eaton research and experimentation, the superiority of metallic sodium as a coolant was proved. And it was in Eaton laboratories that the commercial development of the present Sodium-Cooled Valve was achieved.

Today, in every U. S. bomber and fighter plane, in every PT boat, in many tanks and combat vehicles, the Eaton Sodium-Cooled Valve is helping to put power to work for Victory. And in addition, the vast resources of Eaton research, engineering and manufacturing are producing scores of other vital parts used in every type of mechanized fighting equipment.

Since Eaton pioneered in developing the Sodium-Cooled Valve two decades ago, it has taken a leading part in contributing to America's leadership in transportation. And out of our past seven years of concentrated effort in production for war, important elements are shaping up in the pattern of modern transportation for the world of tomorrow.

EATON

EATON MANUFACTURING CO. • *General Offices:* **CLEVELAND, OHIO**

Plants: Cleveland, Detroit, Saginaw, Marshall, Battle Creek, Lawton, Vassar, Massillon, Windsor (Canada)

EATON AIRCRAFT PRODUCTS: PROPELLER SHAFTS • CRANKSHAFTS • ENGINE VALVES • VALVE TAPPETS • COIL SPRINGS • VALVE SEAT INSERTS • GASOLINE TANK CAPS • FLY WEIGHTS • FORGINGS • ENGINE BOLTS • STAMPINGS • BUSHINGS • RETAINER RINGS • WASHERS • AND OTHER MISCELLANEOUS ENGINE PARTS

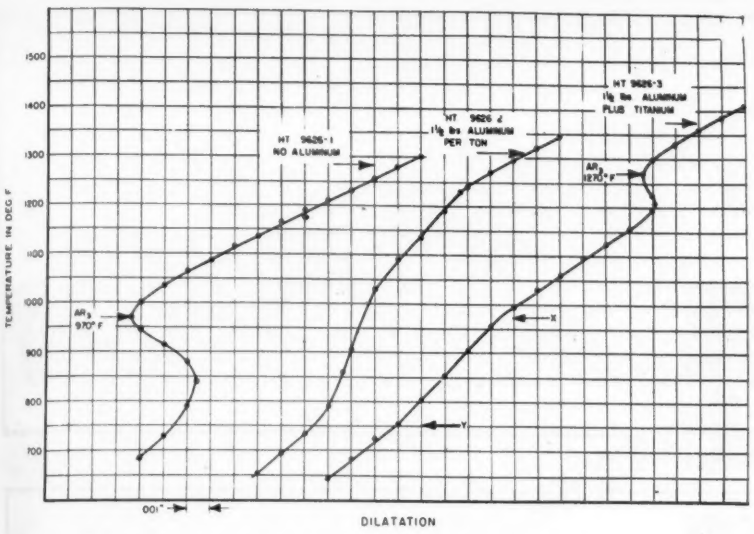


Fig. 11. Dilatometer cooling curves showing the effect of aluminum and titanium additions. (Taken from Tech. Pub. 1847 A.I.M.M.E.)

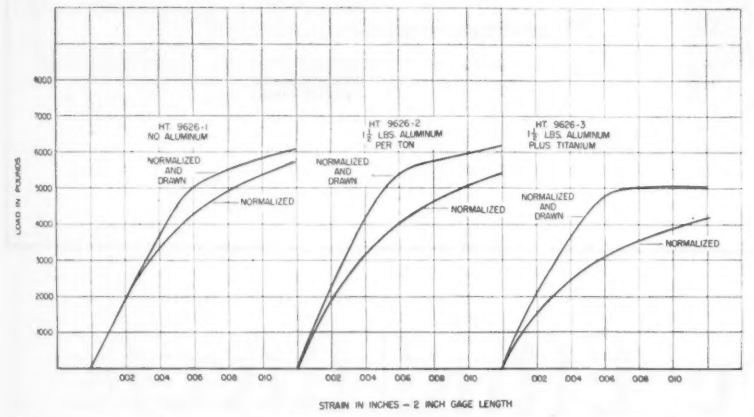


Fig. 12. The above curves illustrate the effect of a 900°F. Draw upon the stress-strain characteristics of normalized stock, the response varying with the deoxidation practice. The plotted load values multiplied by 16 give the stress in lbs. per sq.in. (Taken from Project NRC 514 W.P.B.)

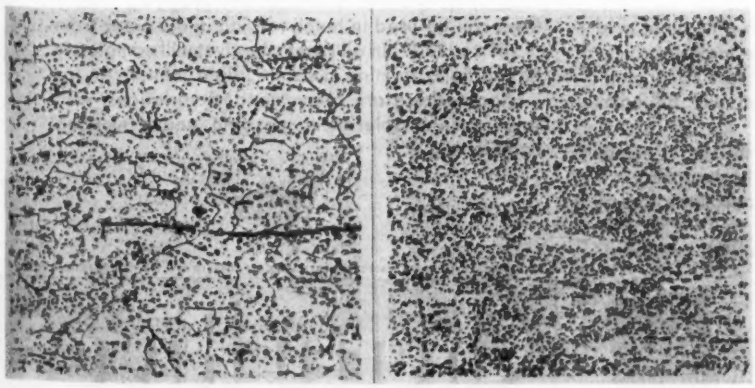


Fig. 14. (*Left*) Steel 9626-1. No aluminum. (*Right*) Steel 9626-2. Aluminum treated. Note difference in carbide size in the microstructures. (Taken from Tech. Pub. 1847 A.I.M.M.E.)

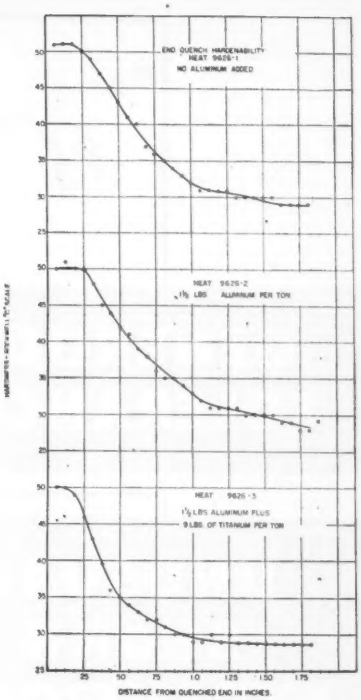


Fig. 13. The above curves show that Steels 9626-1 and -2 have practically identical hardenability, although they differ widely in their cracking characteristics. (Taken from Tech. Pub. 1847 A.I.M.M.E.)

of previous studies in that as the titanium was increased and the carbide particle size increased, there was decidedly less cracking.

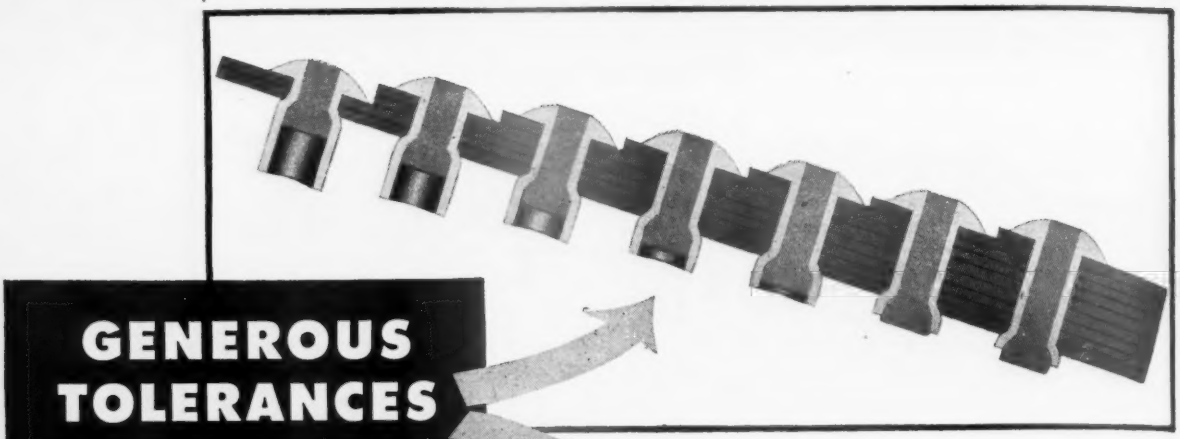
It was interesting in this study to note that NE 8630 steels with carbon as high as 0.40 showed less cracking tendency than the X4130 heats.

To prove further the results of previous studies, three commercial heats of NE 8630 were obtained and were designated in this report as numbers 6, 8, and 10. Numbers 6 and 8 were relatively insensitive to cracking, having indexes of 1.04 and 1.10, whereas steel number 10 was more sensitive to cracking, with a rating of 0.95. Rapid dilatometer studies were made on these three steels and are shown in the curves of Fig. 21. One will again note the two steels having the higher crack insensitivity show the higher A_{R3} temperatures. All other properties of these three steels were similar, so much so that nothing could be gleaned from those properties. It would thus appear that this test for welding crack sensitivity is important in picking out objectionable steel.

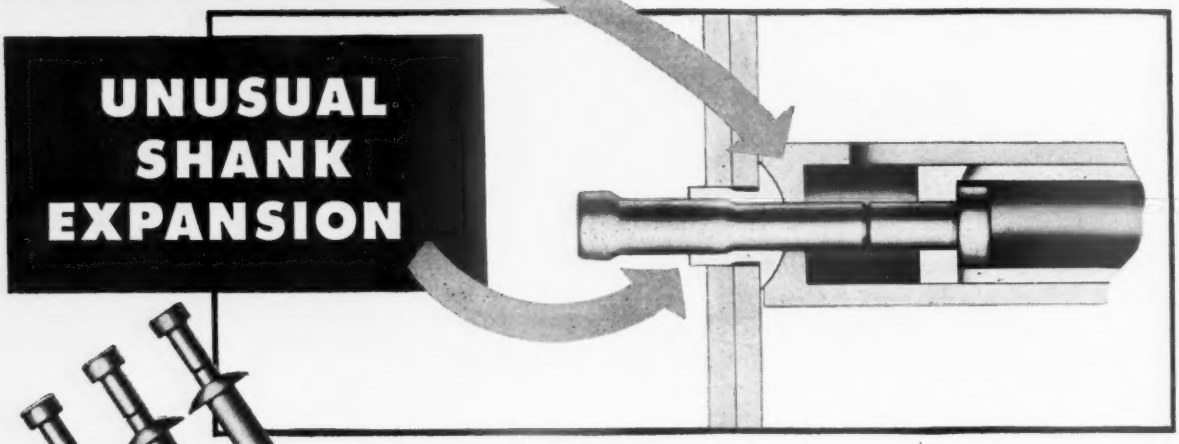
Fig. 22 shows the effect of the carbon equivalent and manganese contents in the three NE 8630 steels mentioned above when plotted against the index of crack sensitivity. These curves show the strong influences of both manganese and other hardenable elements.

Postheating

In the past several years there have been two schools of thought on the subject of heating after welding and the ef-



GENEROUS TOLERANCES



UNUSUAL SHANK EXPANSION

with Cherry Blind Rivets

The material thickness tolerances of Cherry Blind Rivets are generous. The same grip length rivet can be used in materials varying as much as one-sixteenth of an inch.

For example: A Cherry Rivet with a nominal grip length of 1/8" can be used where material thicknesses vary from 5/64" minimum to 9/64" maximum. In all cases the installation will be completely successful.

These are recommended variations. Under actual working conditions, even greater tolerances are possible, as shown in the illustration at the top of this page.

Cherry Rivet hole size tolerances, too, are great. Unusual shank expansion allows recommended variations up to .004", with even greater variations possible under actual working conditions.

A 1/8" nominal diameter self-plugging Cherry Rivet can be used in holes varying in diameter from .128" to .132". In all cases, the rivet will completely fill the hole, forming a secure, rigid joint.

Again, these are recommended variations, with even greater tolerances possible under working conditions.

To get more details, contact your nearest jobber, or write now for illustrated Manual D-45, Dept. A-105, Cherry Rivet Company, 231 Winston Street, Los Angeles 13, California.

CHERRY RIVETS, THEIR MANUFACTURE & APPLICATION ARE COVERED BY U. S. PATENTS ISSUED & PENDING

Cherry Rivet
Company
LOS ANGELES 13, CALIFORNIA

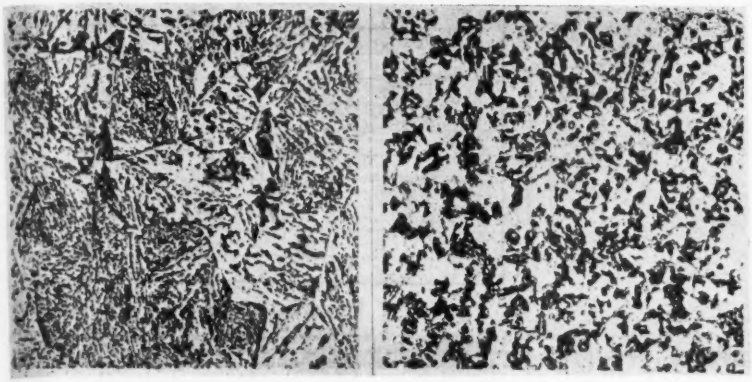


Fig. 15. (*Left*) Steel 9626-1. No aluminum. (*Right*) Steel 9626-2. Aluminum treated. Note difference in normalized structures for these two steels. (Taken from Tech. Pub. 1847 A.I.M.M.E.)

fect of such on the weld-cracking tendencies. This problem was completely investigated in this project, and, after many studies, findings represented by a series of curves were plotted which took into consideration the crack sensitivity test as a criterion for the determination of cracks. Such a series of curves is depicted in Fig. 23. The one curve showing a crack index equal to plus 0.40 shows that the crack sensitivity was increased by that amount for times and temperatures shown on the graph. In other words, if a steel had previously shown a crack index of 0.90, with postheating it became 1.30. This is extremely good. All tests were made on steel 581, which was the steel designated as crack sensitive in the early part of this report. As a further interpretation of this curve, it is expected that all conditions of time and temperature existent to the right of this curve would assure freedom from welding cracks, whereas everything to the left would not. The other curve on this same figure indicates areas that are softer than a Vickers' hardness (300) and probably would not have any commercial interest.

In general, it can be said that the most favorable postheating conditions can be obtained from the S-curve for the particular steel under study and that the most satisfactory results corresponded to the conditions in the S-curve which were most favorable for the formation of bainite.

Hardness Versus Cracking

In the study of the hardness versus the occurrence of cracking there was good correlation between extremely hard or soft materials. However, it was found that in the range of hardness between 500 and 575 Vickers, there was considerable variation in the cracking sensitivity. It was concluded that the reason for this condition was that alpha-martensite was prone to crack, whereas the beta-martensite had a tendency to resist cracking under the same hardness conditions. This correlation of weld hardness with crack sensitivity is shown in Fig. 24.

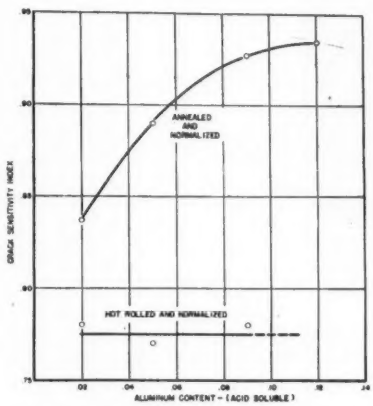


Fig. 16. The above graph shows that the crack sensitivity decreases with aluminum content only when the steel is annealed prior to normalizing. (Taken from Tech. Pub. 1847 A.I.M.M.E.)

Additional Data

Substantiation of the effect of postheating in the welding of low-alloy steels was shown in a paper, "The Effect of Post Heat in Welding Medium Alloy Steels," by Pugacz, Siegel, and Mack, Naval Research Laboratory. In this paper it was found that correlation of time and temperature versus bend tests gave good indication of the value of postheat. Fig. 25 shows a whole series of postheating conditions for various steels. The similarity of findings for like steels is interesting when compared with the findings of the project of W.P.B.

In this article it was concluded that proper times and temperatures are important to realize maximum benefits from postheat. The time of postheat should be long enough to permit complete austenitic transformation. It is indicated that, with postheat considerations, it may be possible to improve design and take advantage of some weight-saving.

It can thus be seen that the proper postheating under controlled conditions can overcome nearly all possible difficulties that occur in welding. It also eliminates the variable that one gets from heat to heat irrespective of best controls.

In summary, it is pointed out that this study has given more insight into the why's of what makes things happen than anything that has been presented before. This information makes available to the steelmaker something concrete which he can do to a steel to sell his product in the best possible condition for best weldability. In addition to this, it gives the fabricator or manipulator a material from the steel mill which he can make into a product that is in such a shape or form that it can be installed into a structure by welding. The purchaser of that material will be reasonably sure that, with the controls of the steelmaking and further control on the fabricated product,

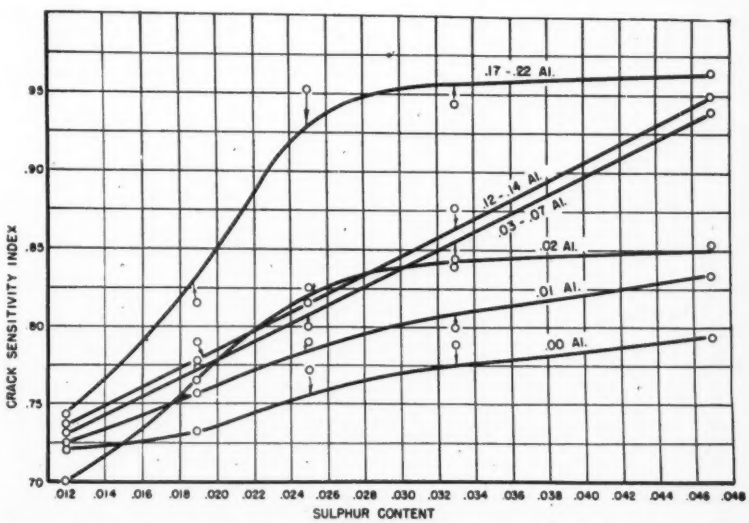


Fig. 17. Curves showing the effects of sulphur and aluminum on crack sensitivity. (Taken from Project NRC 514 W.P.B.)

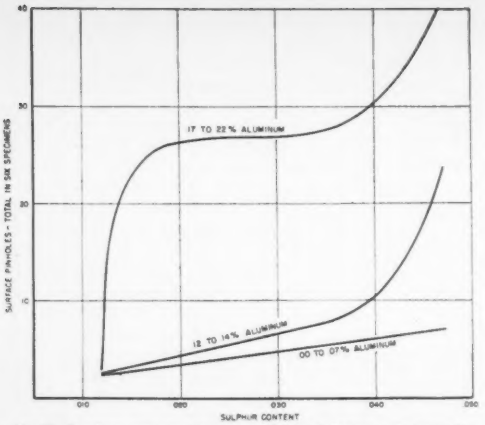


Fig. 18. The above curves show the effect of sulphur and aluminum contents upon the occurrence of surface pinholes in the weld-deposited metal. (Taken from Project NRC 514 W.P.B.)

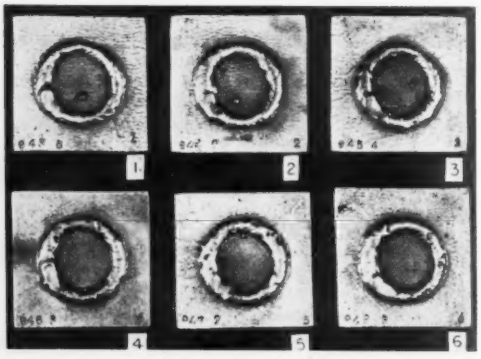


Fig. 19. The above specimen numbers correspond to the amount of aluminum used for deoxidation. Note the surface pinholes in the weld beads on the high-aluminum steels. Specimens 4, 5, and 6. (Taken from Project NRC 514 W.P.B.)

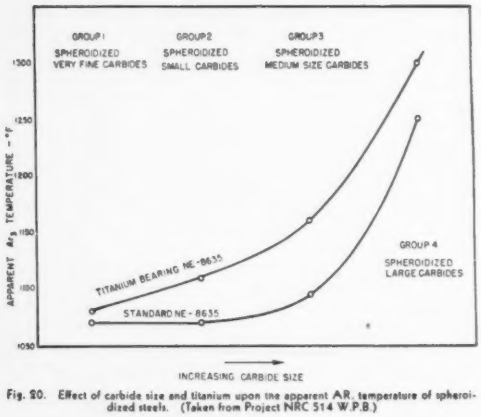


Fig. 20. Effect of carbide size and titanium upon the apparent AR. temperature of spheroidized steels. (Taken from Project NRC 514 W.P.B.)

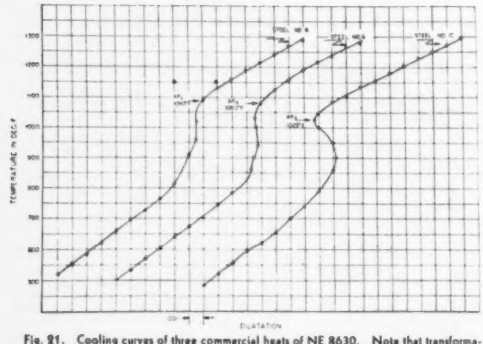


Fig. 21. Cooling curves of three commercial heats of NE 8630. Note that transformation starts at a higher temperature in the insensitive Steels 6 and 8 as compared with the more sensitive Steel No. 10. (Taken from Project NRC 514 W.P.B.)

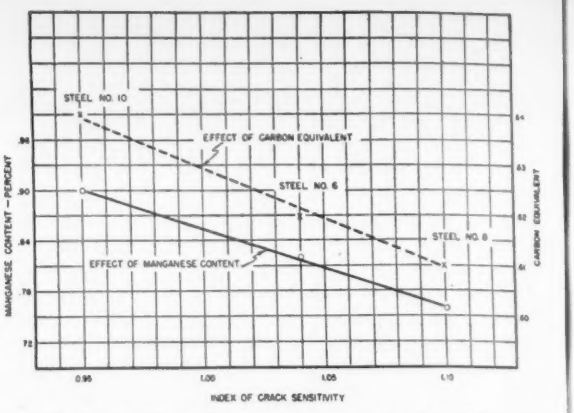


Fig. 22. The strong influence of manganese content upon crack sensitivity is illustrated in the above curves. It will be noted that the carbon equivalent and manganese content curves are practically parallel, indicating that the manganese content is the principal variable among the elements used to compute the carbon equivalent values. The latter values were determined by the following empirical formula:

$$\text{Carbon equivalent} = C + \frac{MN}{6} + \frac{CR}{5} + \frac{MO}{4} + \frac{NI}{15}$$

(Taken from Project NRC 514 W.P.B.)

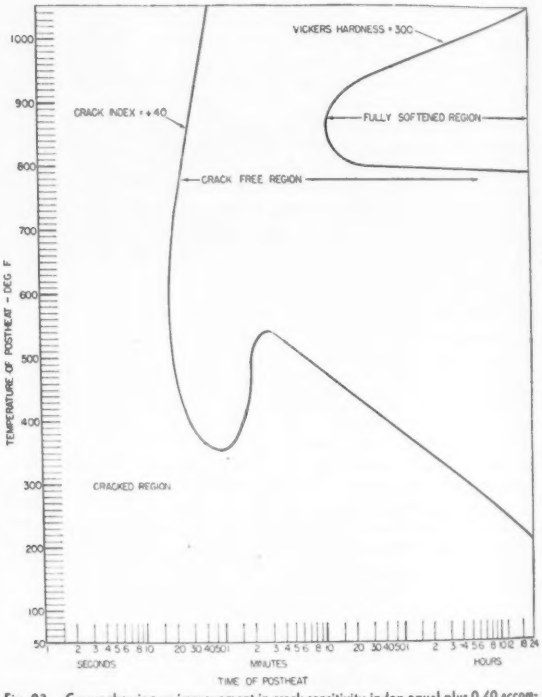


Fig. 23. Curves showing an improvement in crack sensitivity index equal plus 0.40 accomplished by postheating. (Taken from Project NRC 514 W.P.B.)

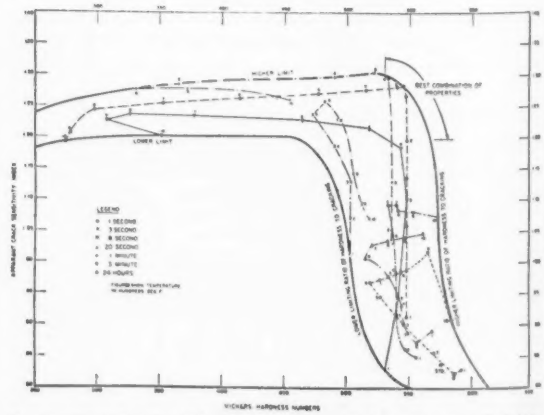


Fig. 24. Correlation of weld hardness with crack sensitivity. (Taken from Tech. Pub. 1847 A.I.M.M.E.)

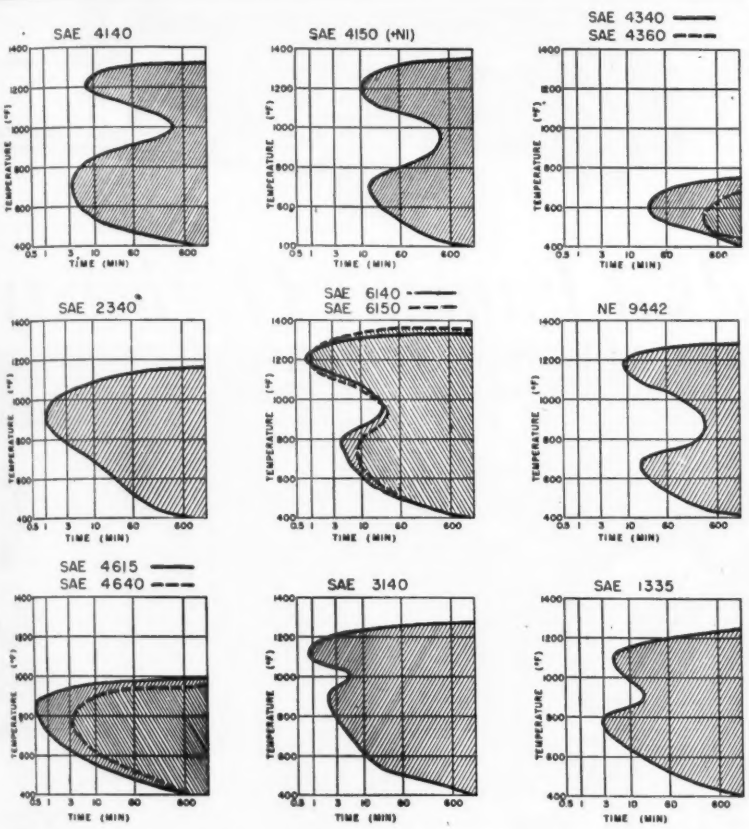


Fig. 25. Note post heating times and temperatures for various steels. (Taken from paper in *Welding Journal*, October, 1944, "Effect of Post Heat in Welding Medium Alloy Steels," by M. A. Pugacz, G. J. Siegel, and J. O. Mack.)

he will have a minimum of difficulty in the welding procedure.

If difficulty is still experienced, the physics of the postheating technique is made available so that welding problems can be eliminated in the place where they occur.

Steel Aircraft Tubing

The whole story of welding cracks in aircraft tubing and sheet (X4130 and 8630, etc.) is interesting and varied in the attempts that have been made to find out the real cause for their existence. The writer has been associated with this subject for approximately 6 years, during which time this subject has been given a lot of concentrated thought by people all over the world.

There are two types of cracks existent: one type is associated with gas welding and the other is associated with arc welding, the latter generally known as "hard cracks." The reasons for the occurrence of these two types of cracks are somewhat different.

Approximately 5 years ago, most of the tube mills decided to adopt the use of electric furnace steel for the production of aircraft tubing. This meant that a better control could be obtained on the various chemical elements in steel and also that the sulphur content (an important element in gas welding) could be brought down to a small amount.

In addition to this, and almost simultaneous with it, a control was put on the melting practice to ensure fine grain steels as determined by the McQuaid-Ehn test. This grain size is controlled primarily by the use of aluminum and other certain features peculiar to steel melting. One can readily see that, as a result of the research on W.P.B. project, the steps taken by the tube mills were in the right direction regarding aluminum additions to steel.

The moves mentioned above had a great deal to do with the reduction in welding cracks. However, there were still cases where there existed this phenomenon in spite of the best control on the steelmaking.

Since arc welding has been the predominant method of welding for the past 2 to 3 years, the presence of hard cracks has been evident, and it was always puzzling as to why certain heats or lots of steel cracked whereas others did not, even though all factors were nearly equal.

It was thought at one time that the tubing used in aircraft construction had to be in the normalized state, and many tube mills produced tubing in this condition under that assumption. In normalizing, however, it has been difficult to produce consistently the yield strength requirements in the Army-Navy specifications. This has brought no end of hardship to mills using the normalizing practice.

As more and more information developed as to the causes of welding cracks and such vital information as found in this investigation, it became possible, with a fuller understanding of the whole problem, to supply aircraft tubing in the cold-drawn and stress-relieved condition with increased confidence.

With the method of manufacture and by supplying tubes in this condition, there is obtained a microstructure that contains spheroidized carbides in the

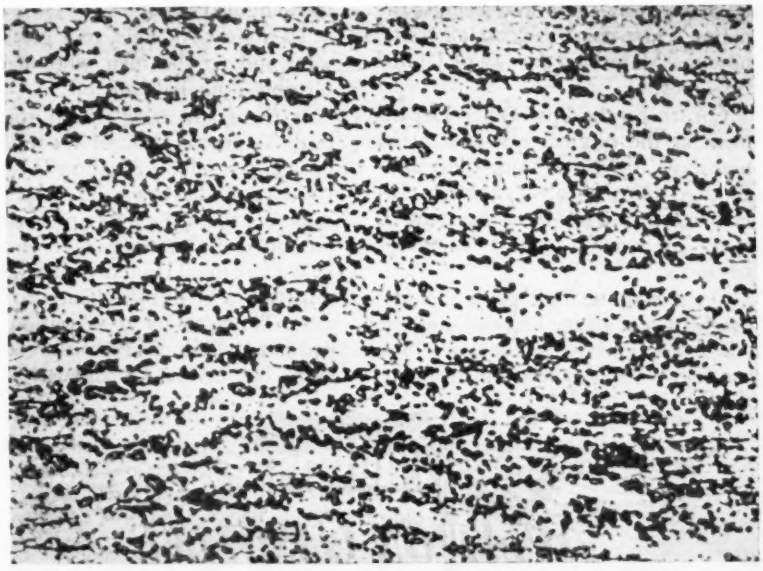
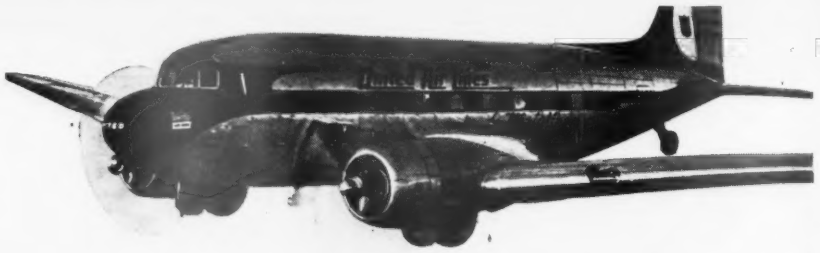
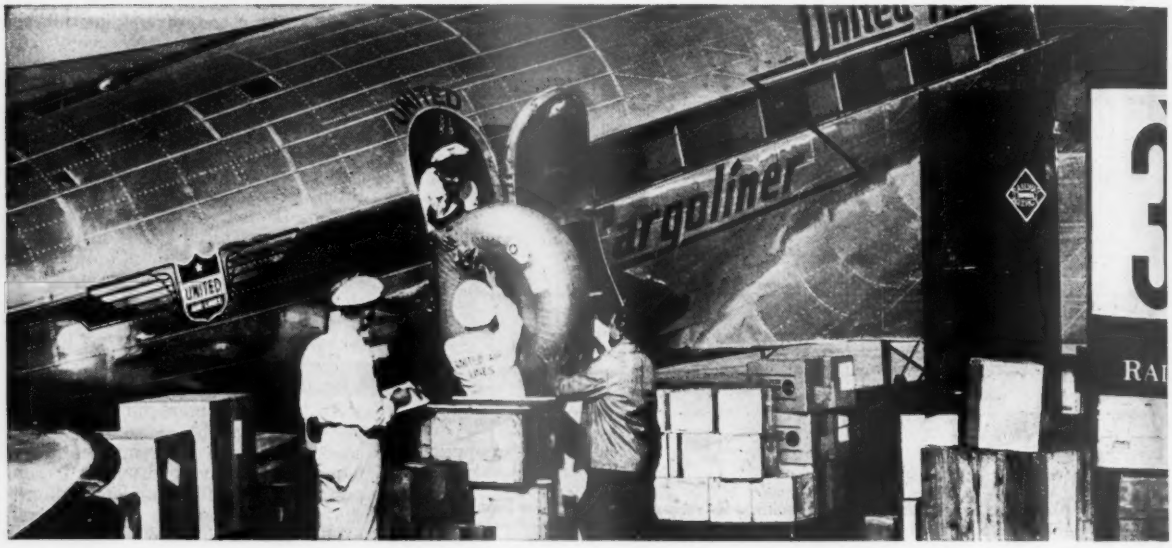


Fig. 26. Note spheroidized carbides in condition *N* aircraft tubing. Cold-work is discernible in the microstructure.



Phillips Hails a Famous Highway



It's The Silver Anniversary of the Main Line Airway—Flown by United Air Lines

TWENTY-FIVE years ago this month a new, immensely important U. S. highway came into being—the nation's first coast-to-coast air route, now the Main Line Airway of United Air Lines!

Chosen by the Post Office Department as the original east-west aerial highway, the New York-Cleveland-Chicago-Omaha-Salt Lake City-San Francisco route has been the scene of many of aviation's most important advances.

On this route took place the first coast-to-coast air mail service, the first scheduled night flying, the first airline use of two-way ground-to-plane radio, and United was the first airline to develop and use three-mile-a-minute twin-engined transports.

To a great Air Line, to a great Airway, and to the men who made it possible—our hats are off!

Is there any *other* reason for this birthday greeting? Sure! We're in the business of selling Aviation Gasoline. United Air Lines is a good customer of ours. We think the best tip-off on *any* product is the kind of people who buy it. We've earned United's approval and respect—we'd like a chance to earn *yours*. Write to us at—Aviation Department, Phillips Petroleum Company, Bartlesville, Oklahoma.

War Production flies the Main Line Airway! Shipments placed aboard United Air Lines Cargoliners in New York at the close of the business day reach Pacific Coast cities next morning.

William Allan Patterson, president, under whose guidance United Air Lines has grown to a 6,300-mile system servicing 53 cities in 17 states, the District of Columbia and one Canadian province.

Phillips
AVIATION GASOLINE

as-shipped material. The procedure for the manufacture of this grade of tubing is to draw with successive passes and subcritical anneals, known as "process anneals," from an appropriate starting size which has been hot-rolled and properly annealed before the start of the cold-drawing. This combination of cold-working and process-annealing develops a spheroidal carbide condition. The yield strength with good elongation is readily obtained, and the ultimate strength is not too high.

Fig. 26 is a photomicrograph showing a typical metallographic structure in finished aircraft tubing. Fig. 27 shows a typical stress-strain curve for cold-drawn and stress-relieved aircraft tubing.

One will note that, based on this recent research, the structure is best for good weldability and that the mechanical properties are excellent. With the proper selection of electric furnace steel, controlled with selected amounts of aluminum, etc., there should exist the best possible grade of material for good weldability. Additional improvement can come from the welder in the form of technique, postheating, preheating, etc.

It can be readily seen that there is a considerable difference between the grade of tubing produced before that time. It is felt that up to the present time aircraft tubing mills, in general, have done everything in their knowledge to produce aircraft tubing that will render the best service in the field. At least, as much has been done regarding the steel quality, metallographic structure, and mechanical properties, as gaged by the knowledge existent up to the present moment, as can be done. Further improvements, however, can be made regarding the general surface conditions, and it is believed that drastic steps have been taken in this direction as well as in an attempt to eliminate decarburization or at least reduce both to a safe minimum.

Thus it can be seen that a great deal of progress has been made, and looking back it appears as though it has been in the right direction based upon constant research and findings as depicted in most recent data.

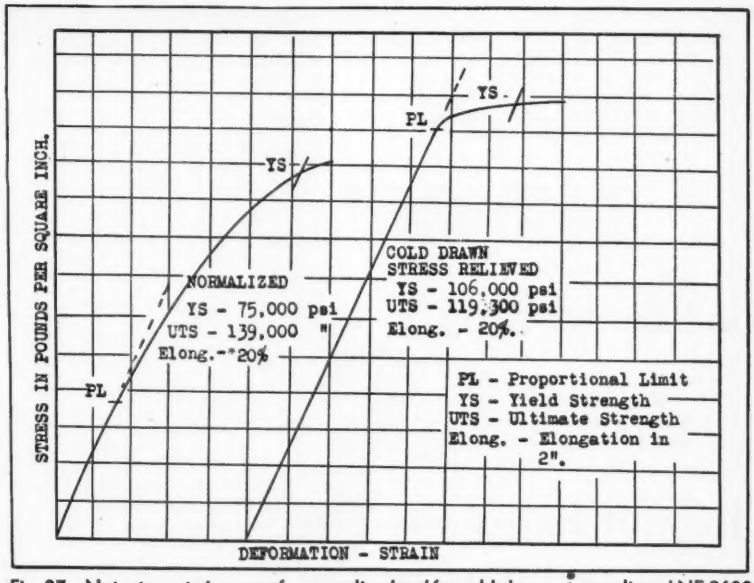


Fig. 27. Note stress-strain curves for normalized and for cold-drawn, stress-relieved NE 8630 tubing. (Aircraft.) Note the differences in proportional limit, yield strength, etc.

In conclusion, it can be stated that there will exist between supplier and user a mutual confidence and understanding on problems that are, and should always have been, mutual in the production of a product. The more that the two parties can get together and understand each other's problems, the better will be the product. It will be necessary to develop along strictly technical lines so that each will understand the other's language. This means that the tendency will be for better welding methods, and it is the problem of the producer to furnish material that gives a minimum of trouble. This can only be done by mutual cooperation.

The interest of the steel manufacturers, together with the tubing producer, in an attempt to give the user what he needs or desires is a happy relationship that should be established immediately and continued in the postwar years.

With this mutual cooperation, there can then be expected a higher degree of safety in steel tubing structures on which there is employed good welding practice and good "tailor-made steel."

If all interested parties will accept reports such as this and make every attempt to understand fully the fundamentals that have been presented, there should result better understanding. There should also result increased production of material for war and for the many items that will be produced or fabricated by welding in the years of peace.

Changes of Address

To facilitate the prompt receipt of copies of the *Journal* and *Review*, members and subscribers are requested to give the editorial offices 30 days' notice of any change of address.

Notices should be sent directly to the Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N.Y.

"KNOW HOW"

in heat treating

How it helps the Aviation Industry

The aviation industry's demands for gears and geared equipment with more strength, longer life and less weight is being met increasingly thru "KNOW HOW" in the heat treating of steel. Metallurgists of Western Gear Works and Pacific Gear & Tool are continuously "blending" into steel, chemical and physical properties that make gears harder, tougher, more resistant to shocks and wear. This unceasing work and experience—"KNOW HOW" in heat treating—is serving the aviation industry by eliminating break-downs and reducing maintenance expense to a minimum. When you want the best in gears, speed reducers and similar geared machinery, phone or write the nearest Pacific-Western plant.

Carburizing B-29 Aircraft Gears

Illustration shows over 400 gears for B-29's going into an electric furnace for carburizing. The temperature is accurately maintained by automatic thermostatic controls during the treatment insuring uniform carburizing.

PACIFIC-WESTERN
GEAR PRODUCTS

PACIFIC GEAR & TOOL WORKS
1035 Folsom St.
San Francisco 3, California

WESTERN GEAR WORKS
617 9th Ave. South, Seattle 4, Wn.
Lewis Bldg., Portland, Oregon
Los Angeles, Calif. — Lynwood, Calif.

Drift Sights

FRED WALLSTEINER*

Kollsman Instrument Division of Square D Company

Introduction

The present-day high-precision drift sight used on airplanes to compute the angle of drift originated in idea years before the Wright Brothers' flight at Kitty Hawk in 1903. In fact, the history of this instrument begins a few years after the invention of the free balloon in 1783. It was found that some device to help in charting the path of the balloon over the ground would be advantageous. When the free balloon developed into the rigid airship or dirigible, the necessity of a method to ascertain the direction of travel over the ground became even more important because flights could now be made to predetermined destinations, using courses plotted before flight.

Development

The fundamental theory of all drift sights depending on the visibility of the ground for indicating the angle of drift has remained the same from the first types constructed to the present models. The accepted method of operation consists of setting a line, wire, or reticle parallel to the apparent direction of movement of the ground and of measuring the angle between that line and the fore-and-aft axis of the aircraft. One of the earlier drift sights consisted of a circular frame with an azimuth scale, mounted so that the zero degree indication was coincident with the fore-and-aft axis of the aircraft. An inner rotatable circle was equipped with diametral drift wires and an index arrow to indicate against the azimuth scale of the stationary frame. The sight was positioned where the navigator could look through it at objects on the ground and turn the movable ring until the objects appeared to travel parallel to the wires.

From this simple drift sight the next development was the use of lenses mounted in a tube similar in construction to a telescope. As early as 1909, patents were applied for on devices to stabilize the optical drift sight by electrically driven gyroscopes. The drift sight developed to this stage proved highly satisfactory in airships and dirigibles, but the designers and manufacturers of airplanes up to and including World War I gave little thought to the instruments. Their immediate problem was to improve the airplane structure and increase the power of the motor. It was only after the airplane passed the experimental stage that the desire to know its performance more accurately became keener and that the demand for instruments became evident. The first instruments to appear on an airplane were engine gages. Flight instruments were next, and gradually, as the range of the plane increased, navigational instruments were necessary.

The drift sight as developed for airships was not practical for single-seater planes. To overcome this difficulty, the same principle of lines was used but in an altogether different manner. The airplane was placed in flying position. A simple form of sighting arrangement was affixed to the side of the cockpit in such a manner that lines drawn on the wing and ground could be sighted. A line was marked on the ground parallel to the fore-and-aft axis of the airplane, starting at a point directly in sight with the leading edge of the wing and extending rearward past the trailing edge. From the point on the ground which was visible over the leading edge, lines were marked on the ground at angles of 5° outward from the fuselage of the plane. Lines were then painted on the wing from the apex on the leading edge of the wing to where the ground lines appeared to cut the trailing edge.

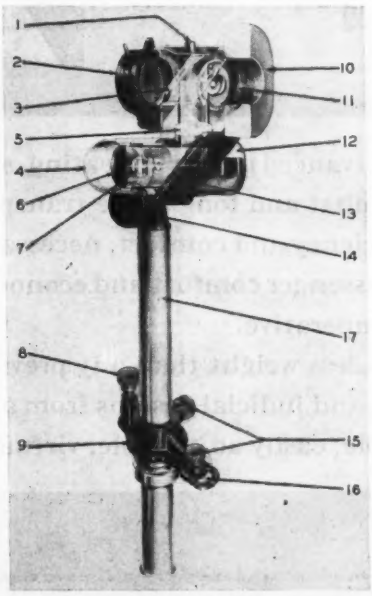


Fig. 1. Picture of pelorus head Mark 2-C. Optical head of the Mark 2-C drift sight: (1) switch; (2) filters; (3) glass mirror; (4) lens; (5) bulb housing; (6) bulb; (7) opaque reticle; (8) pilot screw; (9) index arm; (10) rubber eyeguard; (11) rheostat; (12) dry cell battery; (13) metal mirror; (14) thumb nut; (15) thumb screws; (16) index line; (17) post.

The same process of marking was adapted for both wings, the markings on the port wing indicating starboard drift and vice versa.

The use of these markings was simple. A note was made of any object passing under the apex of the angles on the leading edge, and the point under which it reappeared on the trailing edge indicated the angle of drift. The use of these drift lines on the wings proved useful, but on airplanes where the pilot sat below or before the main wing some other means had to be devised. The horizontal stabilizer, because of its less interrupted view, was then used for drift line markings. The principle for the wing marking was used with the exception that the apex of the angles was the sight affixed to the cockpit instead of the leading edge of the wing. This method of measuring drift evolved what is now the pelorus drift sight Mark 2. Fig. 1 shows the optical head of a Mark 2-C drift sight. With this modern type, the parallax, which was so prevalent in this method of sighting, was eliminated by the use of a reticle focused at infinity by a lens.

With the data gained from actual experience in airplanes and the knowledge of the more advanced types of drift sights used on rigid balloons and dirigibles, the optical drift sight for airplanes was developed.

Theory

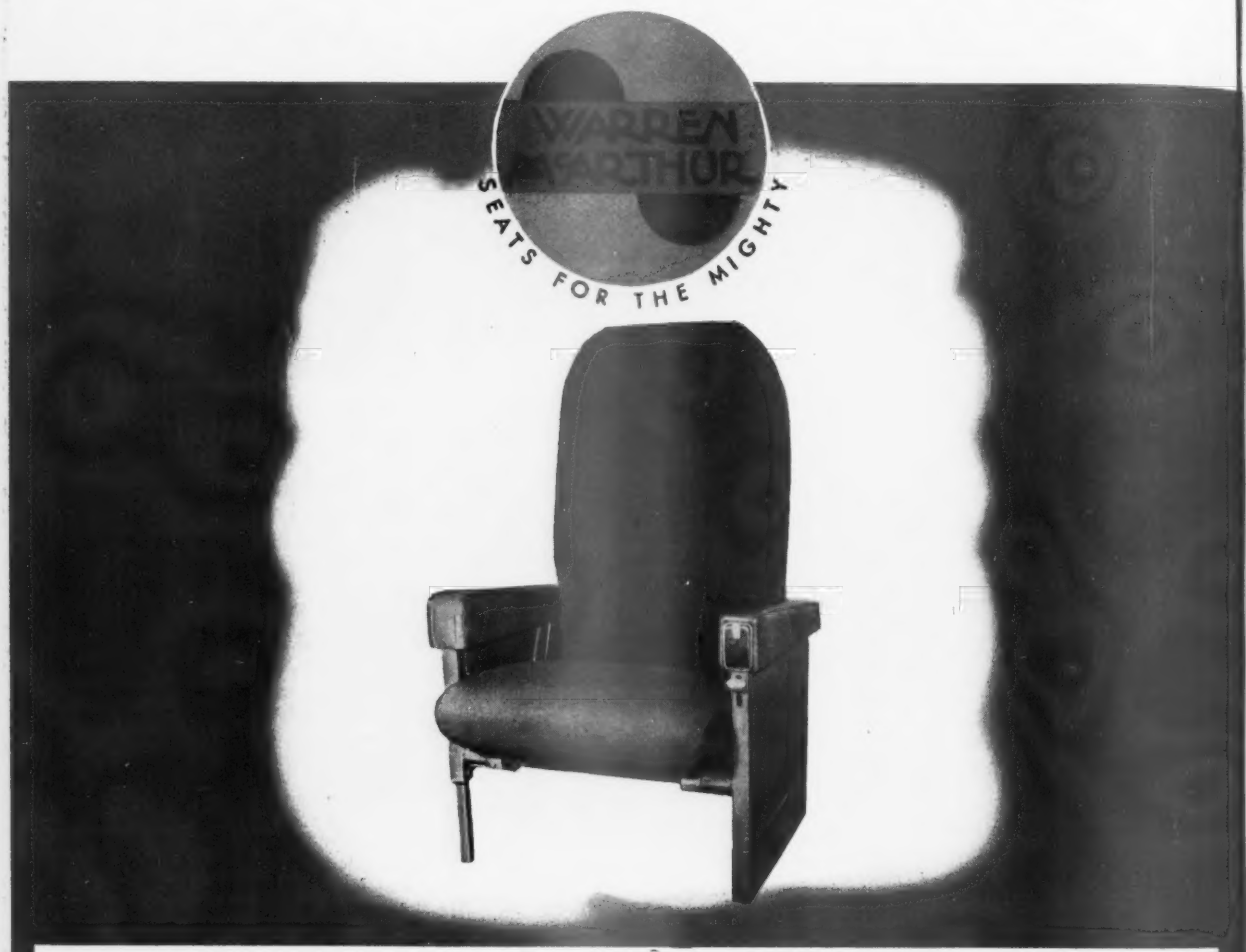
The accuracy of modern navigation requires a drift sight capable of being used for extremely accurate computations. There are three general classifications into which drift sights may be grouped: first, the rotatable grid type; second, the relative bearing type; and, third, a combination of the two.

With the relative bearing type, ground speed may also be computed. Each type may vary in its construction and position to make it adaptable for its location on the airplane—horizontally or vertically mounted. Some drift sights have the image of the reticle stabilized by a gyroscope so that it

Received November 22, 1944.

* Service Engineer.

Banish Flight Fatigue



WARREN McARTHUR advanced technical seating, specified by engineers for more than 85 per cent of combat and long range transport airplanes in the war, has contributed so much to efficiency and comfort, necessary to victory, that peace time requirements of pay load, passenger comfort and economy make world wide adoption of this equipment almost imperative.

Twice as strong, with much less weight than any previously conceived, by virtue of a new fabricating technique and judicial designs from aluminum and magnesium... these seats, supercomfortable, easily adjustable, virtually banish flight fatigue.

WARREN McARTHUR CORPORATION

ONE PARK AVENUE NEW YORK CITY

DESIGNERS, ENGINEERS AND MANUFACTURERS OF AIRCRAFT AND NAVY SEATING

PILOT'S · CO-PILOT'S · NAVIGATOR'S · RADIO OPERATOR'S · REAR GUNNER'S · CAMERA OPERATOR'S · FLIGHT ENGINEER'S · NAVY PATROL STEERSMEN · BOMBARDIER · WARDROOM · OBSERVATION AND TRANSPORT SEATS

moves with the object sighted. Although many types and models are in use today, the operational principle is the same on all drift sights. It is based on the velocity triangle to measure drift and the trigonometric function, tangent θ = opposite ÷ adjacent to measure ground speed.

A plane in flight is affected by two velocities: its own momentum or forward speed and the action of the wind. A velocity is the rate of change of position in any given direction; thus it involves both speed and direction. When two or more velocities act on an airplane at the same time they are called component velocities, and the resultant motion and direction of a plane is called the resultant velocity. Consider an airplane heading due north with a westerly wind. Fig. 2 shows that if the

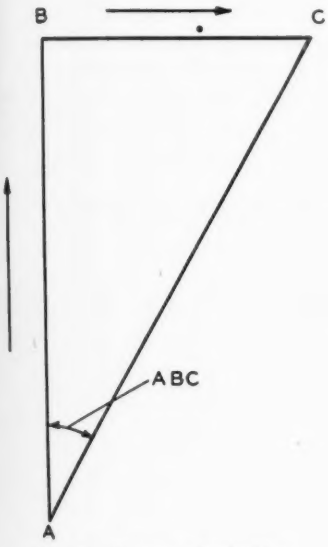


Fig. 2. Diagram of velocities.

course was AB and the wind was BC, the track and ground speed would be AC. The angle ABC would be the angle of drift, which is known as the angle between the apparent direction of motion or heading of an airplane (as indicated by a compass) and the actual motion of the airplane over the ground. It is seldom that a wind will be constant over long distances; therefore, it can readily be seen that the compass heading and the air-speed indication must be corrected if the direction and the distance flown are to be computed accurately. With an optical drift sight that combines both the rotatable grid and relative bearing methods of measurement, these errors can be computed. The Mark 6 drift sight (Fig. 3) as used by the U.S. Navy is a typical instrument of this type.

Operation Instruction

Relative Bearing Method

To compute the angle of drift by making a relative bearing measurement, an object that has been passed over or dropped from the airplane is sighted

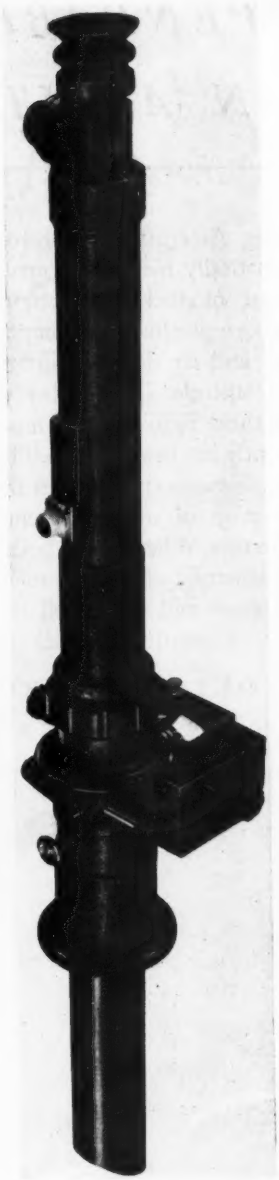


Fig. 3. Picture of Mark 6 drift sight.

through the eyepiece. The line of sight control (trail angle) knob is moved until the object to be used is brought into the field of view. The sight is moved in azimuth until the longitudinal centerline of the grid (reticle) coincides for an instant with the object; the angular displacement of the index line to the right or left is read on the scale as the drift angle. If several readings, a few minutes apart, are made of different objects passed over, the automatic recorder may be used to advantage to obtain an average of the readings. In relative bearing measurements the end of the asymptotic curve recorded on the chart paper should be used for these readings, since this keeps cross trail errors to a minimum. Fig. 4 shows a typical chart paper with the flight recorded for approximately 2 min. by the stylus while making a relative bearing sight. Since yawing of an airplane will introduce an error in drift, an average of several readings should be obtained. A gyroscopic stabilized reticle will improve the accuracy of drift readings when made vertically, but, as the trail angle is increased, the error is also increased, until at 90° the error in bearing due to roll will be equal to the angle of the roll.

In order to use the relative bearing type sight over water, it is necessary to drop a navigational float light or other marker. The float light produces smoke by day and light by night to serve as a reference point on the water. Care must be taken that the point of origin of the smoke is used and that the smoke is not followed after emission has stopped. When a float light or other marker that has been dropped from the airplane is used, a cross trail error is introduced in the reading, since the float light or other marker will not fall exactly on the track except with unusual wind conditions. Although the marker, when dropped, has a forward velocity—the same as the airplane—air resistance will lessen this velocity and cause it to hit the water astern of the airplane instead of below it. An example of cross trail error showing the relative positions of the airplane and marker is shown in Fig. 5. The error is always additive and depends upon the speed, altitude, and drift of the airplane. It should be clear from the diagram that, when using an object dropped from the airplane, the longer the observer waits before taking his reading, the smaller the error in measurement will be because of the decrease in difference between the apparent and true drift.

Grid Line Method

When the angle of drift is to be computed with the grid line method, the trail angle knob is set to zero indication. A detent is provided which will hold it in this position. An object on the

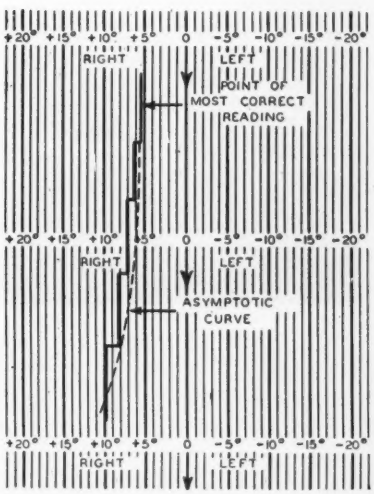


Fig. 4. Chart paper—relative bearing method.

HOLLEY DEPENDABILITY IS AN AVIATION BYWORD

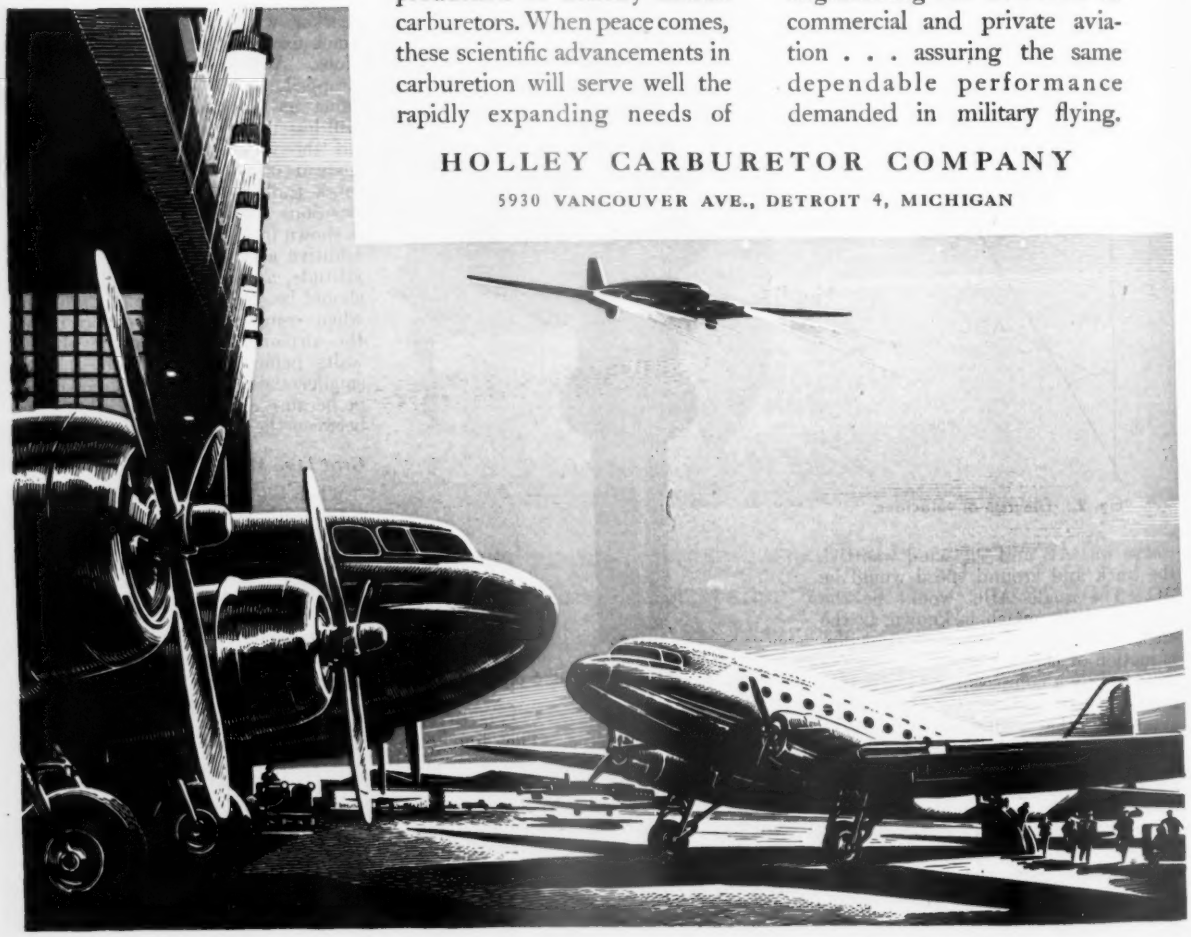
Holley Aircraft Carburetors automatically meter the correct amount of fuel at all engine speeds, engine loads, air temperatures and air densities in any flight attitude. The ability to meet these requirements more efficiently has been increased by Holley's vast experience in the production of military aircraft carburetors. When peace comes, these scientific advancements in carburetion will serve well the rapidly expanding needs of commercial aviation.

Holley superiority is evidenced by the rapidly growing list of users. Holley reliability and precision are bywords among flying men everywhere.

As the aviation pendulum swings from war to peace, Holley research, ingenuity and engineering are available to commercial and private aviation . . . assuring the same dependable performance demanded in military flying.

HOLLEY CARBURETOR COMPANY

5930 VANCOUVER AVE., DETROIT 4, MICHIGAN



HOLLEY

AIRCRAFT, AUTOMOTIVE, MARINE

CARBURETORS AND ACCESSORIES

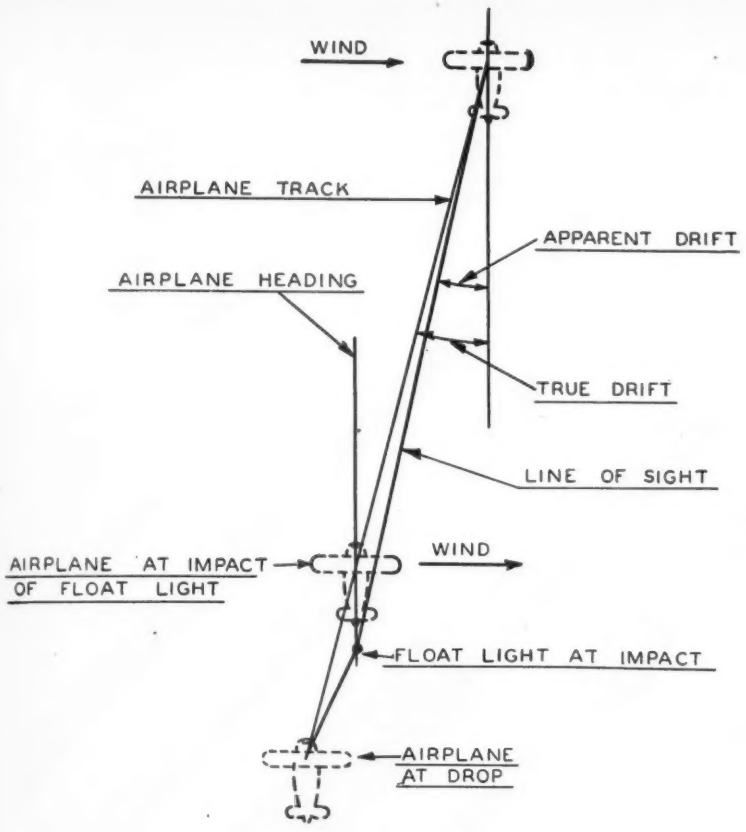


Fig. 5. Diagram of cross trail error.

ground or water moving across the field of vision is sighted. The drift sight is then rotated in azimuth until the object sighted moves parallel to any one of the grid lines. The angular displacement of the index line to the right or left is read on the scale as the drift angle. With this method and by keeping the sight vertical, no correction is necessary for cross trail. When computing angle of drift with the grid line method, the recorder is of great advantage, since an average of the readings may be obtained from the line on the chart as shown in Fig. 6.

Measuring Ground Speed

The ground speed can be approximately determined if the height above the earth's surface (not altitude as read on the altimeter) is accurately known. The best results are obtained when flying over water or level country. It is difficult over mountainous country, since the percentage of error in ground speed will be directly proportional to the percentage of error in altitude. The ground speed is measured by taking the time it takes for the trail angle of a float light or object sighted to change between given angular values. The instrument should be set to the proper drift angle so that the speed can be measured along the track and not in the direction of the heading. The object sighted should be as nearly on the

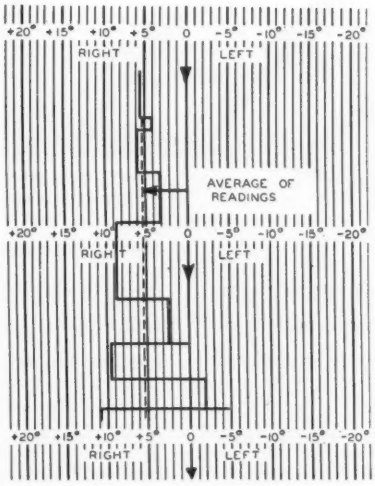


Fig. 6. Chart paper—grid line method.

flight track as possible and centered in the reticle system at the beginning and end of the time interval. Fig. 7 shows diagrammatically the applications of the trigonometric function tangent θ = opposite ÷ adjacent as applied to compute ground speed. The ground speed formula is:

$$V = \frac{0.592H}{t} (\tan \theta_2 - \tan \theta_1)$$

where V is ground speed in knots (if the answer is wanted in miles per hour, the constant 0.682 is substituted for 0.592), H is altitude in feet, and t is the time in seconds from the angle θ_1 at which timing was started to angle θ_2 at which timing is stopped.

Description

It can readily be seen that to accomplish its purpose a drift sight employing a precise optical arrangement must be used. Such a precision instrument is the Kollsman Mark 6 drift sight. In this instrument, the eyepiece is of the nonfocusing type and is permanently set at a focus of −1 diopter; therefore, it requires no adjustment for the individual. A soft rubber eyeguard of liberal dimensions is provided to prevent injury to the eye of the observer in rough air.

The crosslines of the reticle may be illuminated by a bulb for night flying. The bulb is so placed as to render the lines on the reticle visible to the observer with the field otherwise in total darkness. The combined rheostat and "on-off" switch is provided to control the intensity of the light. The wiring is internal from the bulb and rheostat to the connecting receptacle through a fixed resistor in the resistor housing. The bulb may be removed and replaced with the spare bulb, which is screwed in the side of the recording mount.

The line of sight is rotatable in elevation by tilting the reflecting surface of the index prism. The index prism is located at the entrance window of the sight. Its rotational movement is controlled by the trail angle knob through a connecting rod. The trail angle knob is graduated in increments of 5° from 15° forward of vertical to 85° aft of vertical when the plane is in normal flying attitude. A detent is provided to hold the line of sight at zero indication.

A tangent screw is provided for slow rotation of the instrument in azimuth. A locking arm is also provided to hold the tangent screw disengaged when rapid rotation is desired.

Affixed to the rotating portion of the sight and directly over the dial is an index arm with index line and stylus.

The dial is mounted on the stationary mount assembly and has two scales. The outer scale is graduated in increments of 1° to indicate the measurement

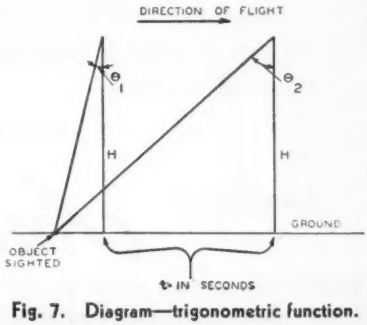
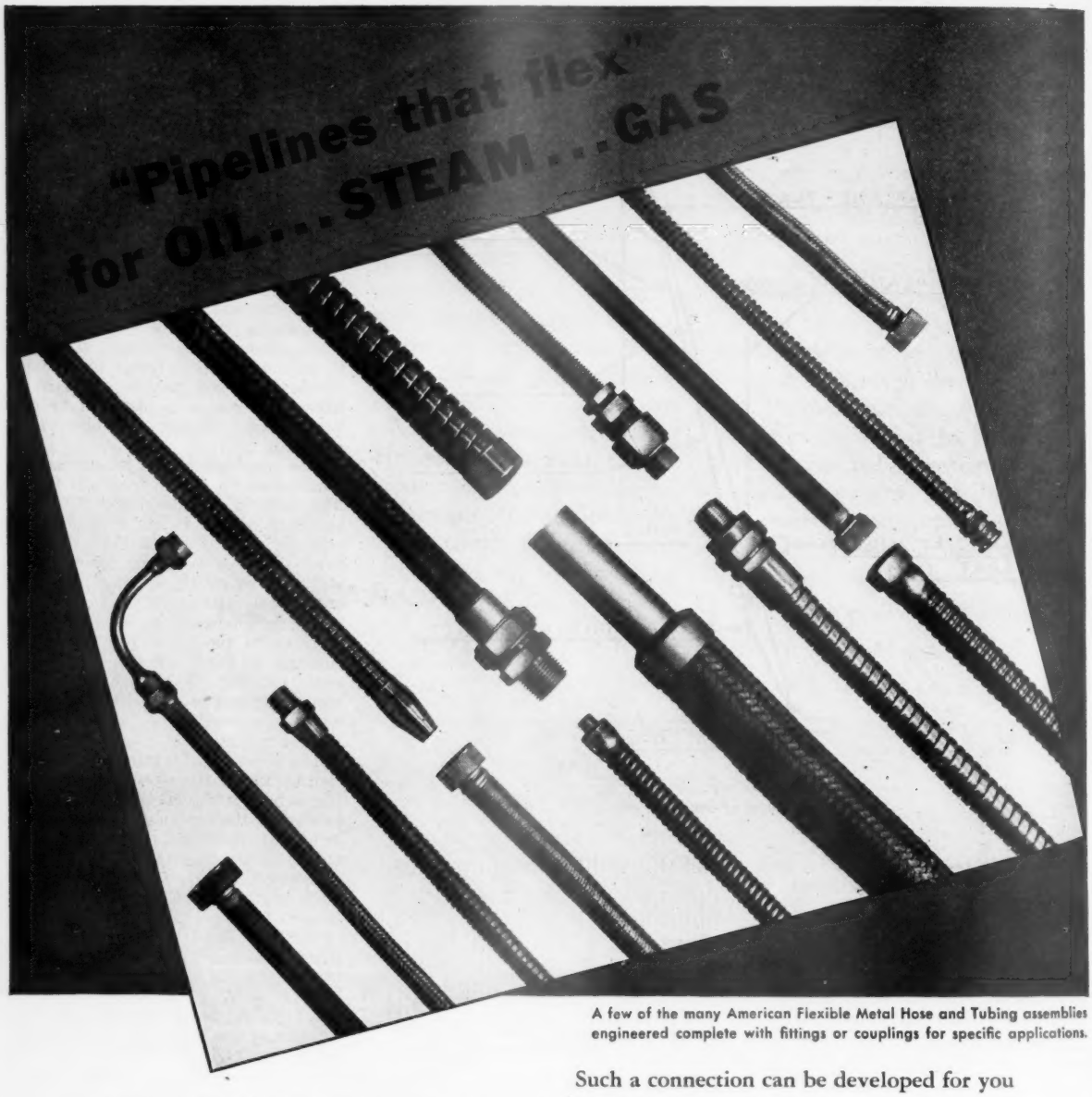


Fig. 7. Diagram—trigonometric function.



A few of the many American Flexible Metal Hose and Tubing assemblies engineered complete with fittings or couplings for specific applications.

VIBRATION or continual movement in a connection is bound to cause trouble sooner or later . . . unless the connection is *engineered* for the job.

Illustrated are a few American Flexible Metal Hose and Seamless Tubing assemblies, each of which *is* designed to meet a specific set of conditions.

Such a connection can be developed for you . . . with the necessary resistance to pressure, temperature, chemical or abrasive action and mechanical stress.

For detailed information on the range of types and sizes of "American" products, write for Publication SS-50. Manufacturers, engineers and machine designers alike will find it a thoroughly practical guide. 45268A

BUY WAR BONDS • Buy all you can • Keep all you buy

ANACONDA from mine to consumer

American Metal Hose

AMERICAN METAL HOSE BRANCH OF THE AMERICAN BRASS COMPANY • General Offices: Waterbury 88, Conn.

Subsidiary of Anaconda Copper Mining Company • In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

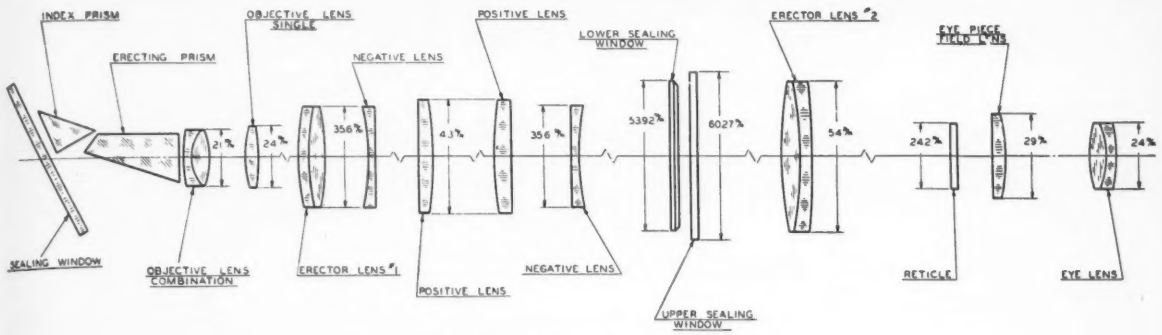


Fig. 8. Schematic lens diagram of Mark 6 drift sight.

of drift up to and including 30° right or left. The inner scale is graduated in increments of 1° to indicate the position of sight in azimuth through 360°.

The chart and driving mechanism of the recording device are located on the stationary mounting sleeve. The recording device, consisting of a spring motor with a stop and start lever, drives through suitable reduction gears a strip paper chart. The chemically sensitive chart paper is printed with longitudinal lines indicating drift at intervals of 2°, with a range of 24° left to 24° right. The stylus is mounted on the index arm, and the point of the stylus rests against the chart to record the drift continuously. The stylus may be adjusted to hold it out of contact with the chart when desired.

The optical system of the Mark 6 drift sight is so designed to control the direction of light rays that the object can be seen when sighting through the instrument in any direction. The unit has a fixed focus that does not magnify and which is set at infinity with a true field vision of 25°. Because there is no magnification, the apparent field is the same as the true field. The diameter of the exit pupil is 9 mm., with an eye distance of 25 mm.

The schematic lens diagram, Fig. 8, shows the arrangement. The lenses and prisms of the Mark 6 drift sight have their light-transmitting surfaces treated with magnesium fluoride to improve the quality of the optical images by reducing reflection from, and increasing transmission through, the optical elements.

With the instrument mounted correctly in the airplane, the most important factor in making accurate drift-sight measurements is good piloting and accurate observations by the navigator.

Library Facilities of the
Institute of the Aeronautical Sciences

To serve Institute members and others in the aeronautical industry, the Institute of the Aeronautical Sciences offers the facilities of:

The W. A. M. Burden Library
1505 RCA Building West
30 Rockefeller Plaza
New York 20, N. Y.

The facilities of this library are available for reference study at the offices of the Institute.

The Paul Kollsman Library
1505 RCA Building West
30 Rockefeller Plaza
New York 20, N. Y.

This library loans books without charge to members and others in the United States over eighteen years of age. Full information will be sent on request.

The Pacific Aeronautical Library
6715 Hollywood Boulevard
Hollywood, Calif.

This is a service and reference library for West Coast organizations. Full information as to its facilities will be sent on request.

An Appreciation

TO CORPORATE MEMBERS OF THE INSTITUTE OF THE AERONAUTICAL SCIENCES

Listed below are the leading aeronautical and industrial companies that make possible the publication of the *Journal of the Aeronautical Sciences*.

They enable the Institute to publish scientific and technical papers in the *Journal* and to devote its pages exclusively to editorial material.

Dues from individual members which would normally be used to publish this scientific and engineering quarterly are thus released for additional services to the profession and industry.

Advertising defrays the cost of publishing the *Aeronautical Engineering Review* and the *Aeronautical Engineering Catalog*.

These publications provide a comprehensive technical information service for the benefit of the aircraft and related industries.

ACADEMY OF AERONAUTICS
ADEL PRECISION PRODUCTS CORPORATION
AERO INSURANCE UNDERWRITERS
AEROJET ENGINEERING CORPORATION
AERONAUTICAL PRODUCTS, INC.
AEROQUIP CORPORATION
AGAWAM AIRCRAFT PRODUCTS, INC.
AIRCHOX COMPANY DIVISION, JOYCE AVIATION, INC.
AIRCRAFT RADIO CORPORATION
AIREON MANUFACTURING CORPORATION
AIRESEARCH MANUFACTURING COMPANY
  AIRESEARCH MANUFACTURING COMPANY OF ARIZONA, INC.
AIREX MANUFACTURING COMPANY, INC
ALLIS-CHALMERS MANUFACTURING COMPANY
ALLISON DIVISION, GENERAL MOTORS CORPORATION
ALUMINUM COMPANY OF AMERICA
AMERICAN AIRLINES SYSTEM
AMERICAN BOSCH CORPORATION
AMERICAN CENTRAL MANUFACTURING CORPORATION
AMERICAN PHENOLIC CORPORATION
THE AMERICAN ROLLING MILL COMPANY
AMERICAN TUBE BENDING COMPANY, INC.
ASSOCIATED AVIATION UNDERWRITERS
ASSOCIATED FOUNDRIES & MANUFACTURERS, INC.
BAKER STEEL & TUBE COMPANY
BAUSCH & LOMB OPTICAL COMPANY
BEECH AIRCRAFT CORPORATION
BELL AIRCRAFT CORPORATION
BENDIX AVIATION CORPORATION
  BENDIX PRODUCTS DIVISION
  BENDIX RADIO CORPORATION
  ECLIPSE-PIONEER DIVISION
  EXPORT DIVISION
  JULIEN P. FRIEZ & SONS DIVISION
  PACIFIC DIVISION
  SCINTILLA MAGNETO COMPANY
THE BG CORPORATION
BOEING AIRCRAFT COMPANY
BOEING SCHOOL OF AERONAUTICS
BOLTON MANUFACTURING CORPORATION
BOOTS AIRCRAFT NUT CORPORATION
BREEZE CORPORATIONS, INC.
  ESSEX TOOL & DIE COMPANY
  FEDERAL LABORATORIES, INC.
CARRIER CORPORATION
CESSNA AIRCRAFT COMPANY
CHANDLER-EVANS CORPORATION
CHASE NATIONAL BANK OF THE CITY OF NEW YORK
THE CLEVELAND GRAPHITE BRONZE COMPANY
THE CLEVELAND PNEUMATIC TOOL COMPANY
  AUTOMOTIVE-AIRCRAFT DIVISION
CLIFFORD MANUFACTURING COMPANY
CONSOLIDATED VULTEE AIRCRAFT CORPORATION
  NASHVILLE DIVISION
  STINSON AIRCRAFT DIVISION
CONTINENTAL MOTORS CORPORATION
COX AND STEVENS AIRCRAFT CORPORATION
CULVER AIRCRAFT CORPORATION
CURTISS-WRIGHT CORPORATION
  AIRPLANE DIVISION
  DEVELOPMENT DIVISION
  PROPELLER DIVISION
  WRIGHT AERONAUTICAL CORPORATION
DOAK AIRCRAFT COMPANY, INC.
DOUGLAS AIRCRAFT COMPANY, INC.
  EL SEGUNDO PLANT
  LONG BEACH PLANT
THE DOW CHEMICAL COMPANY
DZUS FASTENER COMPANY, INC.
EASTERN AIR LINES, INC.
EATON MANUFACTURING COMPANY
THOMAS A. EDISON COMPANY, INC., INSTRUMENT DIVISION
EDO AIRCRAFT CORPORATION
ELASTIC STOP NUT CORPORATION OF AMERICA
THE ELECTRIC AUTO-LITE COMPANY
ELECTROL INCORPORATED
ENGINEERING AND RESEARCH CORPORATION
ETHYL CORPORATION
THE FAFNIR BEARING COMPANY
FAIRCHILD CAMERA & INSTRUMENT CORPORATION
  FAIRCHILD AERIAL SURVEYS, INC.
FAIRCHILD ENGINE AND AIRPLANE CORPORATION
  DURAMOLD DIVISION
  FAIRCHILD AIRCRAFT DIVISION
  RANGER AIRCRAFT ENGINES DIVISION
FEDERAL TELEPHONE AND RADIO CORPORATION
FIRESTONE AIRCRAFT COMPANY
FLEETWINGS DIVISION, KAISER CARGO, INC.
FLETCHER AVIATION CORPORATION
G & A AIRCRAFT, INC.
GENERAL AIRCRAFT EQUIPMENT, INC.
GENERAL AVIATION EQUIPMENT COMPANY, INC.
GENERAL ELECTRIC COMPANY
GENERAL INSTRUMENT CORPORATION
GENERAL MOTORS CORPORATION
  AC SPARK PLUG DIVISION
  AEROPRODUCTS DIVISION
  BUICK MOTOR DIVISION
  CADILLAC MOTOR CAR DIVISION
  CHEVROLET MOTOR DIVISION
  DELCO PRODUCTS DIVISION
  DELCO-REMY DIVISION
  EASTERN AIRCRAFT DIVISION
  FISHER BODY DIVISION
  FRIGIDAIRE DIVISION
  HARRISON RADIATOR DIVISION
  RESEARCH LABORATORIES DIVISION
  ROCHESTER PRODUCTS DIVISION
GENERAL TIRE & RUBBER COMPANY
THE B. F. GOODRICH COMPANY
THE GOODYEAR TIRE & RUBBER COMPANY
GRAND CENTRAL AIRPORT COMPANY
THE GRAY MANUFACTURING COMPANY
GRUMMAN AIRCRAFT ENGINEERING CORPORATION
GUIBERSON DIESEL ENGINE COMPANY
W. & L. E. GURLEY
HANNA ENGINEERING WORKS
HASKELITE MANUFACTURING CORPORATION
HAYES INDUSTRIES, INC.
HIGGINS AIRCRAFT, INC.
THE INTERNATIONAL NICKEL COMPANY
JACK & HEINTZ, INC.
JACOBS AIRCRAFT ENGINE COMPANY
JOHNS-MANVILLE SALES CORPORATION
CASEY JONES SCHOOL OF AERONAUTICS, INC.
KELLETT AIRCRAFT CORPORATION
KENYON INSTRUMENT COMPANY, INC.
WALTER KIDDE & COMPANY, INC.
KOLLSMAN INSTRUMENT DIVISION, SQUARE D COMPANY
LAISTER-KAUFFMANN AIRCRAFT CORPORATION
LANGLEY CORPORATION
LAVELLE AIRCRAFT CORPORATION
LEAR INCORPORATED
LIBERTY AIRCRAFT PRODUCTS CORPORATION
LIGHTS, INCORPORATED
LINK AVIATION DEVICES, INC.
THE LIQUIDOMETER CORPORATION
LOCKHEED AIRCRAFT CORPORATION
LONGINES-WITTNAUER WATCH COMPANY, INC.
MAGNAFLUX CORPORATION
THE MARQUETTE METAL PRODUCTS COMPANY
THE GLENN L. MARTIN COMPANY
WARREN McARTHUR CORPORATION
McDONNELL AIRCRAFT CORPORATION
MENASCO MANUFACTURING COMPANY
MICROMATIC HONE CORPORATION
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY
MOORE DROP FORGING COMPANY
NASH-KELVINATOR CORPORATION
NATIONAL CITY BANK OF NEW YORK
NATIONAL CREDIT OFFICE, INC.
THE NATIONAL SCREW & MANUFACTURING COMPANY
THE NEW YORK AIR BRAKE COMPANY
NOORDUYN AVIATION LIMITED
NORMA-HOFFMANN BEARINGS CORPORATION
NORTH AMERICAN AVIATION, INC.
  NORTH AMERICAN AVIATION, INC., OF TEXAS
NORTHROP AIRCRAFT, INC.
NORTHWEST AIRLINES, INC.
OTTO AVIATION CORPORATION
OWENS-CORNING FIBERGLAS CORPORATION
PACKARD MOTOR CAR COMPANY
PAN AMERICAN AIRWAYS SYSTEM
THE PARKER APPLIANCE COMPANY
PENNSYLVANIA-CENTRAL AIRLINES CORPORATION
PESCO PRODUCTS COMPANY DIVISION, BORG-WARNER CORPORATION
PHILLIPS PETROLEUM COMPANY
PIONEER PARACHUTE COMPANY, INC.
THE PURE OIL COMPANY
REPUBLIC AVIATION CORPORATION
J. P. RIDDLE COMPANY
RIDGEFIELD MANUFACTURING CORPORATION, AIRCRAFT DIVISION
JOHN A. ROEBLING'S SONS COMPANY
ROHR AIRCRAFT CORPORATION
ROMEC PUMP COMPANY
ROOSEVELT FIELD, INC.
THE RYAN AERONAUTICAL COMPANY
SCIAKY BROTHERS
SCOTT AVIATION CORPORATION
SHAKESPEARE PRODUCTS COMPANY
SHELL OIL COMPANY, INC.
SIMMONDS AEROCESSORIES, INC.
SKYDYNE, INC.
SOCONY-VACUUM OIL COMPANY
SOLAR AIRCRAFT COMPANY
SPERRY GYROSCOPE COMPANY, INC.
SQUARE D COMPANY
STANDARD OIL COMPANY OF CALIFORNIA
STANDARD OIL COMPANY (INDIANA)
STANDARD OIL COMPANY OF NEW JERSEY
STEEL IMPROVEMENT & FORGE COMPANY
SUMMERILL TUBING COMPANY
SWEDLOW AEROPLASTICS CORPORATION
TELEFLEX LIMITED
THE TEXAS COMPANY
THOMPSON PRODUCTS, INC.
TINNERMAN PRODUCTS, INC.
TITEFLEX, INC.
TRANSCONTINENTAL & WESTERN AIR, INC.
TRIPLETT & BARTON, INC.
UNION CARBIDE AND CARBON CORPORATION
  BAKELITE CORPORATION
  HAYNES STELLITE COMPANY
  LINDE AIR PRODUCTS COMPANY
  NATIONAL CARBON COMPANY
UNITED AIRCRAFT CORPORATION
  CHANCE VOUGHT AIRCRAFT DIVISION
  HAMILTON STANDARD PROPELLERS DIVISION
  PRATT & WHITNEY AIRCRAFT DIVISION
  PRATT & WHITNEY AIRCRAFT CORPORATION OF MISSOURI
  SIKORSKY AIRCRAFT DIVISION
UNITED AIR LINES, INC.
UNITED STATES AVIATION UNDERWRITERS, INC.
UNITED STATES RUBBER COMPANY
  DOMINION RUBBER COMPANY, LTD.
UNIVERSAL MOULDED PRODUCTS CORPORATION
THE VARIETY AIRCRAFT CORPORATION
VICKERS, INC.
VICTOR ADDING MACHINE COMPANY
VIDAL RESEARCH CORPORATION
THE WACO AIRCRAFT COMPANY
WARNER AIRCRAFT CORPORATION
THE WEATHERHEAD COMPANY
WESTERN AIRLINES, INC.
WESTINGHOUSE ELECTRIC CORPORATION
WESTON ELECTRICAL INSTRUMENT CORPORATION
WYMAN-GORDON COMPANY
YOUNG RADIATOR COMPANY

ELECTRIFYING the Road to Tokyo

Curtiss Electric Propellers now add to the demonstrated effectiveness of the Boeing B-29 Superfortress:

Greater striking force—made possible by propeller weight reduction.

Shortened landing runs—through aerodynamic braking.

Automatically synchronized propeller speeds.

The unmatched durability of hollow steel blades.

The additional safety of electrical propeller control, unaffected by temperature and altitude and with minimum vulnerability to combat damage.

These new advantages for the Superfortresses on the road to Tokyo mean new destruction for the enemy and increased security for B-29 crews.

CURTISS

Electric Propellers

DIVISION OF **CURTISS WRIGHT** FIRST IN FLIGHT

NEW STYLING, YES—AND NEW LONG WEAR

THE FINEST TRIBUTES to the automotive industry are the cars themselves. The war has revealed their true measure of stamina — the soundness of design and materials that has helped keep America rolling. And, the *next* cars will be even better, for new materials with still greater wear and serviceability will be available. For example, door linings and car interior paneling made from BAKELITE laminating plastics will stay new-looking for the entire life of the car. Smudges and stains will be quickly removed with a damp cloth, and the paneling will be highly resistant to marring. Laminated plastics will also make possible new interior styling effects that will have outstanding sales appeal.

Door linings and paneling made from BAKELITE laminating plastics are light in weight and resistant to impact, abrasion, moisture, oils, and greases. The paneling is made in a wide range of permanent colors and decorative effects. Luminescent pigments can also be incorporated in the laminated structure.

Booklet 25-P, "A Simplified Guide to BAKELITE and VINYLITE Plastics," includes a wealth of possibilities for the use of plastics in the automotive field. A copy will be sent you immediately upon request.

TRADE MARK

BAKELITE CORPORATION

Unit of

Union Carbide and Carbon Corporation

UCC

30 EAST 42ND ST., NEW YORK 17, N. Y.

The Influence of the Earth's Rotation on Bubble Sextant Readings

J. J. GREEN*

Air Transport Board, Canada

Introduction

It has been known for some time that the earth's rotation affects the bubble of the bubble sextant used in aircraft, necessitating the application of a correction that increases in magnitude with increase in latitude and increase in ground speed.

Tables listing the correction as a function of ground speed and latitude are given in the *Air Almanac* and in such texts as *Air Navigation* by P. V. H. Weems. These tables would indicate that the correction to be applied is independent of the course of the aircraft.

The theoretic treatment given below would suggest, however, that the correction is dependent in part on the direction of motion of the aircraft.

Theoretic Treatment

The existing tables are based on the presence of a lateral acceleration equal to $2\omega v \sin l$ acting to the right in the N. hemisphere and to the left in the S. hemisphere, where ω = angular velocity of the earth, v = velocity of aircraft, and l = latitude.

In the theoretic treatment given herewith the term $2\omega v \sin l$ is augmented by an additional term dependent on the course flown and, in computing the angular correction to the bubble sextant reading the acceleration due to gravity, which appears in the denominator, is also modified by terms arising from the motion of the aircraft.

Let r denote the radius of the earth and ω its angular velocity.

Consider an aircraft of mass m, at latitude l, traveling at speed v in direction (true) denoted by θ (see Fig. 1).

Then $v \cos \theta$ is its northerly component of velocity, and $v \sin \theta$ is its easterly component of velocity.

The angular momentum of the aircraft is

$$m(\omega r \cos l + v \sin \theta) r \cos l = m\omega r^2 \cos^2 l + mv \sin \theta (r \cos l)$$

By differentiating this expression with respect to time, the rate of change of angular momentum is equal to

$$-m\omega r^2 (2 \cos l)(\sin l)(dl/dt) - mvr \sin \theta \, (\sin l)(dl/dt)$$

but $dl/dt = (v \cos \theta)/r$ and the rate of change of angular momentum is equal to the moment of the external force $(F) = Fr \cos l$. The external force, F, therefore equals

$$-2m\omega v \cos \theta (\sin l) - (mv^2/r) \sin \theta (\cos \theta)(\tan l)$$

and the lateral acceleration on the aircraft (acting easterly) is

$$2\omega v \cos \theta \sin l + (v^2/r) \sin \theta \cos \theta \tan l$$

The centrifugal force C acting on the aircraft when at rest on the ground is given by

$$m\omega^2 r \cos l \text{ or } m(V^2/r \cos l)$$

where V is the surface velocity of the earth at latitude l.

This is augmented by the easterly motion of the aircraft in flight to

$$m(V + v \sin \theta)^2/r \cos l$$

Hence, the increase in centrifugal force is

$$C = (m/r \cos l)(2Vv \sin \theta + v^2 \sin^2 \theta)$$

The tangential or lateral component of this force is

$$(m/r \cos l)(2Vv \sin \theta + v^2 \sin^2 \theta) \sin l$$

but $\omega = V/r \cos l$ and the lateral acceleration on the aircraft (acting southerly) is therefore

$$2\omega v \sin \theta \sin l + (v^2/r) \sin \theta \sin \theta \tan l$$

Combining the two lateral accelerations, the resultant acceleration is

$$2\omega v \sin l + (v^2/r) \sin \theta \tan l$$

This resultant acceleration acts at an angle θ to the E-W direction and, hence, is at right angles to the path of the aircraft, positive values being to the right in the N. hemisphere and to the left in the S. hemisphere.

Now the vertical component of the increased centrifugal force caused by the easterly component of the velocity of the aircraft is

$$2m\omega v \sin \theta \cos l + (mv^2/r) \sin^2 \theta$$

and $(mv^2/r) \cos^2 \theta$ caused by the northerly component of the velocity.

(*Continued on page 115*)

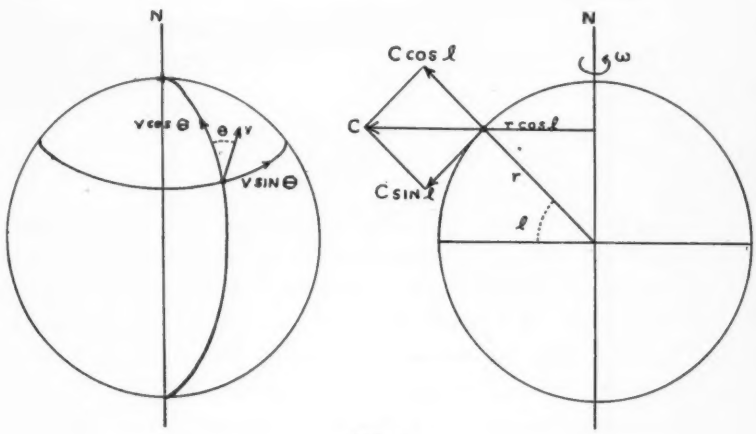


Fig. 1.

Table 1
Error in Minutes of Arc

Latitude	Course of Aircraft, θ: 0°, 180°	45°, 135°	90°	270°	225°, 315°	Values Given by *Air Almanac*
0	0	0	0	0	0	0
10°	1.59′	1.81′	1.90′	1.27′	1.37′	1′
20°	3.13′	3.59′	3.78′	2.48′	2.67′	3′
30°	4.57′	5.29′	5.60′	3.54′	3.84′	5′
40°	5.87′	6.92′	7.36′	4.38′	4.82′	6′
50°	6.98′	8.48′	9.10′	4.88′	5.50′	7′
60°	7.89′	10.05′	10.95′	4.84′	5.73′	8′
70°	8.55′	11.97′	13.39′	3.73′	5.14′	9′
75°	8.79′	13.43′	15.35′	2.24′	4.16′	..
80°	8.96′	16.00′	18.92′	− 0.99′	1.92′	..
85°	9.08′	23.24′	29.12′	−11.00′	−5.12′	..

Received April 17, 1945.

*Chief Research Aeronautical Engineer.

A case of dual personality

WE'RE not exactly twins—but we certainly have a dual personality! One side of us designs and builds top notch aircraft hydraulic equipment. Our other side designs and builds electronic communication equipment. Mr. Freud, doubtless, would have been puzzled by this duplicity, but our customers, at least, see the sense of it. This dual personality is merged completely in the Aireon hydraulic and electronic equipment which ride together on thousands of planes ☛ When you call Aireon you'll learn how well these two personalities are knit into one red hot engineering and production unit. So why not get in touch with the *Messrs.* Aireon today?

Aireon MANUFACTURING CORPORATION

Radio and Electronics • Engineered Power Controls

NEW YORK • CHICAGO • KANSAS CITY • BURBANK

Institute News

Institute Members to Study German Scientific Secrets

Numerous members of the Institute have been appointed to a group of nongovernment civilian technical specialists who have been sent to Europe to engage in an extensive investigation of German technology. Among one group representing the aeronautical industry are the following: Richard H. Depew, Jr., Manager of Special Projects, Fairchild Aircraft Division, Fairchild Engine & Airplane Corporation; Joseph V. Foa, Head of Design Section, Research Division, Curtiss-Wright Corporation's Airplane Division; Harold E. Gray, Assistant General Manager, The BG Corporation; William C. Heath, Chief Engineer, Solar Aircraft Company; Otto E. Kirchner, Chief Engineer, American Airlines System; Robert W. Kluge, Aircraft Structures Engineer, Bell Aircraft Corporation; Edward J. Minser, Superintendent of Meteorology, Transcontinental & Western Air, Inc.; Hugh J. Mulvey, Structural Design Engineer, Kellett Aircraft Corporation; Andre P. E. Planiol, Vice-President, Stratos Corporation; Warren A. Shuping, Chief Inspector, Fairchild Aircraft Division, Fairchild Engine & Airplane Corporation; John D. Waugh, Technical Editor of Public Relations, Curtiss Propeller Division, Curtiss-Wright Corporation.

Gifts to the Aeronautical Archives

The British Joint Staff Mission, through the courtesy of Air Marshal Douglas Colyer, sent a stereopticon and 600 slides showing bomb damage in Germany and German-occupied Europe.

Complete files of the *Royal Air Force Journal* and of *Aircraft Recognition* were received from the Air Information Office of the Royal Air Force Delegation through the courtesy of Wing Comdr. E. W. Russell.

W. A. M. Burden sent 275 aeronautical periodicals, adding to his previous generous gifts. A portfolio of colored lithographs of modern aviation "firsts," autographed by Frank Lemon, the artist, was received from Wright Aeronautical Corporation through the courtesy of William B. Birren. Two letters written to him by Orville and Wilbur Wright were given by Carl Dienstbach, the pioneer and early writer on aviation. A set of a 16-side phonograph recording of the dedication of the Southern California Cooperative Wind Tunnel, May 3, 1945, was given by the International Business Machines Corporation. A phonograph recording of the broadcast of the First Annual Air Forces Day, including speeches of Gen. H. H. Arnold and others, was received from James McKenzie-Reid of Station WOR. Two 16-mm. sound films, *Wright Builds for Air Supremacy* and *Power by Wright*, were sent by Wright Aeronautical Corporation, through the courtesy of D. E. Camp. The Convalescent Services Division of the Army Air Forces gave a file of its *Information Letter*.

Dr. Alexander Klemin added pamphlets and manuscripts to his previous generous gifts. Bendix Helicopter, Inc., gave aeronautical periodicals, adding to its previous gifts. The British Air Commission gave seventeen additional *R.T.P. Translations*.

Schedule frequency maps for Africa, Australia, Canada, and several Latin American countries and surveys of air transportation in Latin America and Africa were given by the Civil Aeronautics Board. A descriptive name plate of engraved silver on a mahogany base, to accompany the model of the Army Sikorsky XR-4 helicopter given to the Archives last month by Col. H. F. Gregory, was sent by the Rotary Wing Branch of the Engineering Division, Air Technical Service Command.

Two gold lapel pins were received from Pennsylvania-Central Airlines Corporation. A six-months' service lapel pin was sent by National Airlines, Inc. A lapel pin of Aerovias Nacionales de Columbia was received from Ralph Underdahl. A German submarine name plate was sent by the Lincoln Electric Company. A piece of German 88-mm. flak was received from Austin G. Cragg.

Additional gifts were received from the Aircraft Industries Association of America, Inc.; American Society of Mechanical Engineers; American Society for Testing Materials; Batelle Memorial Institute; Braniff Airways, Inc.; British Information Services; DoAll Trade School; Irish Stationery Office; Pan American Airways, Inc.; Switlik Parachute Company; Transcontinental & Western Air, Inc.; Turco Products, Inc.; United Air Lines, Inc.; Uruguay Dirección de Aeronáutica Civil; the U.S. Air Technical Service Command of the Army Air Forces; Civil Aeronautics Board; National Bureau of Standards; Office of Education; Office of War Information; War Department; War Production Board; and the House and Senate Document Rooms.

Corporate Members Expand

Menasco Manufacturing Company has announced the purchase of the Malabar Manufacturing Company, producers of hydraulic jacks used by the aircraft, railroad, and automotive industries. The purchase, involving approximately $425,000 cash, will add the Malabar group of hydraulic jacks to the list of Menasco products, as a part of the company's plans for reconversion to peacetime production.

Westinghouse Electric Corporation has expanded its operations by the acquisition of the B. F. Sturtevant Company, of Boston, Mass., a pioneer in the design and manufacture of air-handling and processing equipment. The Sturtevant organization becomes a wholly owned Westinghouse subsidiary, operating as the B. F. Sturtevant Company, a Division of Westinghouse Electric Corporation.

The Sturtevant company's products serve a wide range in the fan and blower field and in heating, cooling and air-conditioning apparatus, including application and design of complete air-handling and processing systems for industry. The headquarters of these Westinghouse activities will be located at Boston.

New Staff Member

Lt. Austin G. Cragg, who served overseas as a pilot with a heavy bombardment group in the 15th Air Force, has been honorably discharged from the Army and has joined the staff of the AERONAUTICAL ENGINEERING REVIEW and AERONAUTICAL ENGINEERING CATALOG, published by the Institute.

Lt. Cragg completed 43 combat missions and was awarded the Distinguished Flying Cross, the Air Medal with two Oak Leaf Clusters, and the Purple Heart Medal.

Sections and Branches

Cleveland Section

Willson H. Hunter has taken over the temporary chairmanship of the Cleveland Section, following the resignation of John Weske, who has joined the Faculty of Rensselaer Polytechnic Institute. The Section plans to hold an election of officers in the near future, arranging for their terms to extend for a little more than a year, so as to return to the basis of electing officers in October.

N·A·S Internal Wrenching Bolts

COLD FORGED BY "NATIONAL"

Applications subject to unusual stress, where extremely high torquing and fatigue resistance are required, call for NAS Internal Wrenching Bolts.

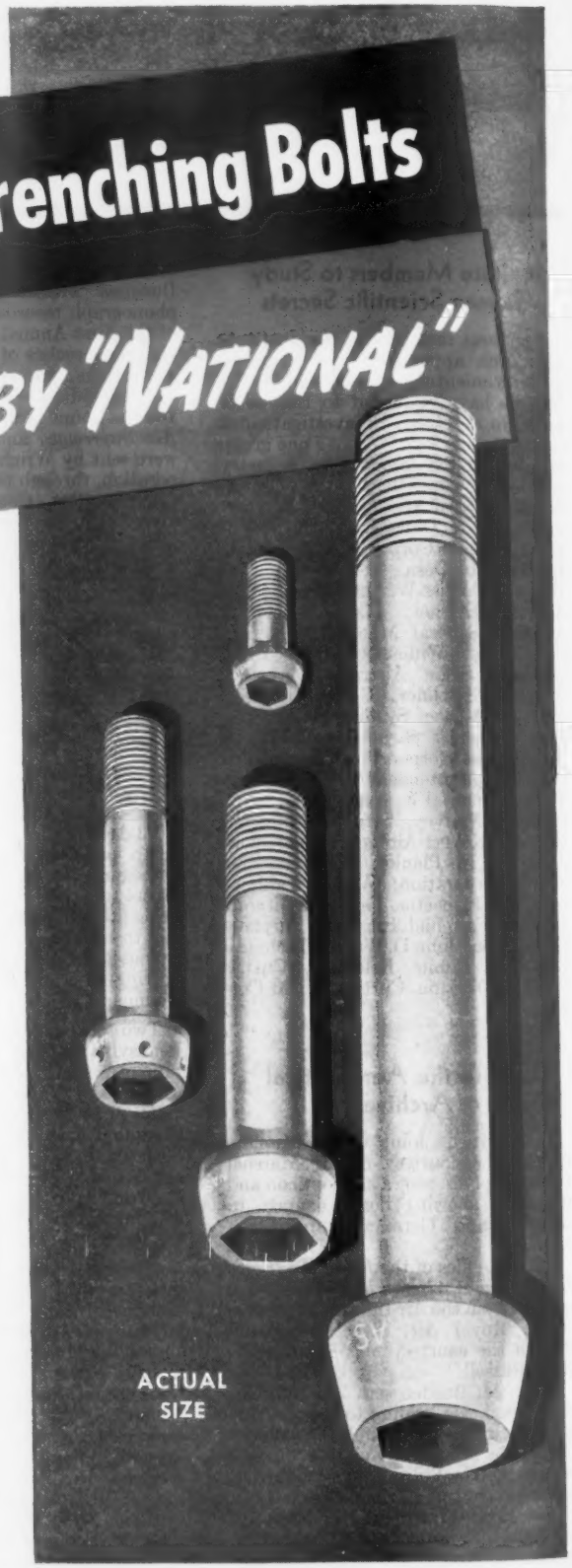
We make them from high-grade alloy steel, heat-treated to 160,000-180,000 p.s.i. tensile strength. The hex socket is cold forged (not machined), resulting in more uniform and better controlled grain flow of the metal. This method affords positive assurance of the *required strength on every bolt.*

Threads are made by the rolled thread process, producing an unbroken grain flow and consequently greater strength. Thread runout at the grip has a rounded root, thereby avoiding the sharp stop caused by other methods of threading.

The entire shank, underside of head and radius have ground surfaces.

"National's" close co-operation with engineers of the aircraft industry in the progressive development and improvement of Internal Wrenching Bolts has made us a prime source of supply for these important aircraft fasteners.

National HEADED AND THREADED PRODUCTS



THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.

At a meeting on May 24, held at the Cleveland Hotel, Mr. Hunter, Chief of the Icing Research Division of the Aircraft Engine Research Laboratory of the N.A.C.A., gave a paper on "Notes on Icing in Civil Aviation."

Philadelphia Section

A meeting of the Philadelphia Section took place on June 27 at the Engineers Club of Philadelphia. J. E. McDonald, Chief Aerodynamicist of the G & A Aircraft Company, gave a paper titled "Discussion and Demonstration of Dynamics of Rotor-Craft Ground Resonance."

Discussion was held of papers to be presented at the meetings during the coming year. Various topics were suggested, it being emphasized that subjects other than rotary wing aircraft be considered. The six papers that have been volunteered by Section members were discussed, as were plans for stimulating a larger attendance at meetings and for increasing the membership of the Section.

University of Colorado

University of Colorado Student Branch elected the following officers at a meeting held on August 8: Chairman, J. L. Fletcher; Vice-Chairman, R. W. Young; Secretary, E. B. Kasari; Treasurer, L. G. Lautman.

Georgia School of Technology

On July 13 the Georgia School of Technology Student Branch held a meeting at which the following officers were elected: Chairman, C. B. Cliett; Vice-Chairman, D. B. Ross; Secretary, W. J. Oakes; Treasurer, H. H. Armstrong.

On July 27 a talk was given by Lt. N. W. Richardson, a discharged veteran, now attending college at Georgia Tech. He spoke of his experiences in the Army Air Forces during bombing missions prior to the invasion of Normandy.

Illinois Institute of Technology

The Student Branch of the Illinois Institute of Technology elected the following officers on July 20: Chairman, Allan Kukral; Vice-Chairman, David Meyers; Secretary-Treasurer, Joseph Vieceli.

Iowa State College

Professor L. Kelso is now Faculty Adviser for the Iowa State College Student Branch in place of Prof. Wilbur C. Nelson.

Massachusetts Institute of Technology

Professor Otto C. Koppen has been appointed Faculty Adviser for the Massachusetts Institute of Technology Student Branch, succeeding Prof. Richard H. Smith.

I. A. S.

Special Meetings Schedule

1945

October 4–5, 1945
DETROIT MEETING

October 25, 1945
WASHINGTON MEETING

December 17, 1945
WRIGHT BROTHERS LECTURE, Washington, D.C.

The Officers and Council of the Institute invite participation in the Technical Sessions of the Meetings of the Institute.

The Meetings Committee will consider for inclusion on the program complete papers, or outlines or summaries of proposed papers.

Information for Participants

(1) Complete papers, or outlines or summaries should be submitted in triplicate at least four months prior to the meeting at which it is proposed to present the paper. Outlines or summaries should not exceed 1,000 words.

(2) Each paper should be so planned that it may be presented within a time limit of 45 minutes.

(3) All papers submitted will be considered for publication in the **Journal of the Aeronautical Sciences** or the **Aeronautical Engineering Review.** While a paper should be planned to take only 45 minutes for presentation at a meeting, the written presentation may have a maximum length of approximately 15,000 words.

(4) All material received will be submitted to the Meetings Committee. Authors will be notified, in ample time to prepare the complete paper, whether or not their papers can be scheduled for presentation.

All correspondence should be addressed to
The Meetings Committee
Institute of the Aeronautical Sciences
1505 RCA Building West
30 Rockefeller Plaza
New York 20, N. Y.

POSTWAR AIRCRAFT

WILL BENEFIT FROM THE LESSONS OF THE WAR

The record for dependability and effectiveness of Flex-O-Tube Flexible Hose Assemblies throughout the war years on such notable aircraft as the Curtiss Wright Helldiver, the Consolidated Vultee B-24, the Boeing B-29, the Republic P-47, the Curtiss C-46, the Grumman Hellcat, the Atlantic Clipper, etc., is convincing proof of their ability to handle the toughest type of service.

Is there any better reason for designing them into the private and commercial planes that will carry our postwar air traffic?

THE **Flex-O-Tube** COMPANY

LAFAYETTE at 14th AVE., DETROIT 16, MICHIGAN
Offices: CHICAGO · FORT WORTH
LOS ANGELES · NEW YORK
SEATTLE · TORONTO, ONT.

University of Michigan

At a combined business and technical meeting of the University of Michigan Student Branch the following officers were elected: Chairman, LaVern W. Scudder; Vice-Chairman, Henry Brem; Secretary, Robert H. Kreiger; Treasurer, John Peterson. Dr. A. M. Kuethe, Acting Chairman of the Department of Aeronautical Engineering, gave a talk on supersonic flight, which was accompanied by illustrative slides.

University of Notre Dame

The Notre Dame Student Branch held a reorganization meeting on July 20 at which the following acting officers were elected: Chairman, Verne R. Hubka; Vice-Chairman, David A. Norton; Secretary, Robert Snyder.

It was decided to hold meetings bimonthly through October 12. It was decided also that a Test Library will be placed in operation the coming semester and that *The Burble* would be published as usual.

Polytechnic Institute of Brooklyn

At a meeting of the Polytechnic Institute of Brooklyn Student Branch on July 10, Dr. H. Reissner was the guest speaker. His topic was the design of a "duck type" airplane. The features of this design include a tricycle landing gear and wings of corrugated metal. The speaker stated that the craft was designed in 1910 and flew successfully, but, because of stability problems, it was not used during the first World War. Dr. Reissner's talk was supplemented by the showing of motion pictures of the craft in flight and details of its construction. The speaker answered questions at the conclusion of the talk.

Dr. Nicholas J. Hoff, Associate Professor of Aeronautical Engineering of Brooklyn Polytechnic, presented awards on behalf of the Institute to H. Lew and C. Dolkas, for scholarship and outstanding contributions to the Student Branch.

Purdue University

The following officers were elected to serve for the July–November term: Chairman, Frank Nickols; Vice-Chairman, Richard H. Ludwick; Secretary, William L. MacReynolds; Treasurer, Alan A. Dale.

Spartan College of Aeronautical Engineering

A business meeting was held on July 14 at which Miss Ellen Chanell was elected Treasurer. A discussion was held of the constitution of the Student Branch, and plans were made for future meetings.

On July 28 a meeting was held at which Captain Terell of the Air Transport Command gave a talk about "Problems of the Maintenance Engineer in War." He described incidents that occurred in Europe and told how some of the problems were solved. Two motion pictures were shown, *The Bell Helicopter* and the *Flying Cannon*.

Virginia Polytechnic Institute

The Student Branch of Virginia Polytechnic Institute held a meeting on July 12. Professor L. Z. Seltzer gave a talk in which he described the functions of the Institute for the benefit of freshman members. Plans were discussed for a future social gathering.

At a meeting on July 31 the films *Manufacturing Methods* and *Aircraft Hydraulic Systems* were shown.

Wichita University

A belated report from the Wichita University Student Branch states that at a meeting held on April 19, the film *The Lightning P-38* was shown. It was decided that, because of the pressure of work resulting from the fact that students are employed in war plants as well as attending college, the student awards would be held over until September, giving the students the summer vacation in which to prepare their talks.

On May 21 the film *Fairchild PT-19 Trainer* was shown. It was decided that the present officers would remain in office until the first meeting of the next semester.

News of Members

Bruce E. Del Mar will receive the Junior Award of the American Society of Mechanical Engineers for 1945 in recognition of his paper "Presentation of Centrifugal Compressor Performance in Terms of Non-Dimensional Relationships."

William F. Durand, Chairman of the Division of Engineering and Industry of the National Research Council, has been selected to receive the American Society of Mechanical Engineers Medal, highest honor of the A.S.M.E., for 1945. The award will be presented late in November in recognition of his work in the hydrodynamic and aerodynamic sciences, particularly in forwarding the design and application of the principles of reaction propulsion and his service to the Government in engineering research.

Arvid G. Edenquist has been elected Vice-President and Assistant to the President of Pacific Airmotive Corporation.

Donald W. Eno has reported for active duty as a Lieutenant (j.g.) in the U.S. Naval Reserve.

Harold Gatty, who participated in a record flight around the world with Wiley Post in 1931, has returned to the Pacific-Alaska Division of Pan American World Airways. He will assist the company in establishing its proposed world-wide plans for international air service.

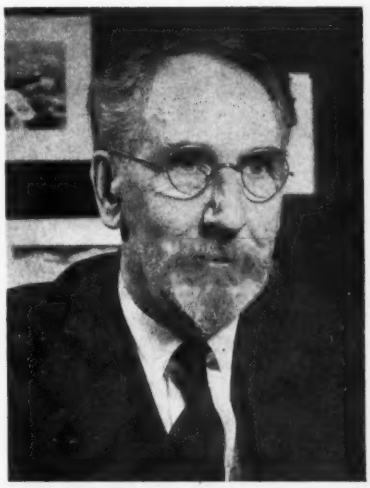
Darwin L. Holbrook has been promoted to the position of West Coast Manager for The Fafnir Bearing Company.

Milton D. Hunnex has entered the U.S. Navy as Seaman 1st Class.

Norman Jump has been elected President of Airdraulics, Inc.

Maria Z. Krzywoblocki was the first recipient of the Degree of Doctor of Aeronautical Engineering of the Polytechnic Institute of Brooklyn. The degree was conferred at the recent ninetieth commencement exercises of Polytechnic Institute.

Ludwig G. Lederer has been advanced to the position of Director of Personnel Administration of Pennsylvania-Central Airlines.



Sanford A. Moss, Consulting Engineer at the River Works of General Electric Company, Lynn, Mass., will receive the Holly Medal of the American Society of Mechanical Engineers. The award was given for his pioneer work in superchargers, which has contributed so greatly to the altitude, speed, and range of modern aircraft.

Vice Admiral J. S. McCain, U. S. Navy, former commanding officer of Task Force 38, died of a heart attack at his home on September 6. A full necrology will appear in the October issue.

Ben A. Neffson has joined the staff of the Ryan Aeronautical Company.

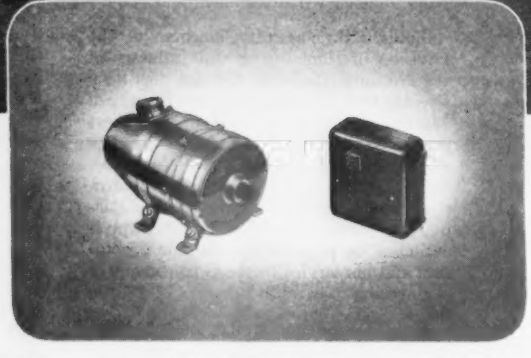
Arthur K. Peck has become a partner in the firm of Stevens & Legg.

Paul H. Peck has joined the staff of the Massachusetts Institute of Technology at the Radiation Laboratory.

Rear Adm. D. C. Ramsey, U.S. Navy, formerly Chief of the Bureau of Aeronautics of the Navy Department, has become Chief of Staff of the United States 5th Fleet.

Frederick F. Robinson has been elected a member of the Board of Directors of Bell Aircraft Corporation.

Above, A Transatlantic "Flying Ace" takes off for Europe with capacity load of passengers, mail, and cargo.



Left, Cabin Thermostat and Power Unit which automatically control cabin temperature in the "Flying Aces."

BARBER-COLMAN CONTROLS

HAVE SET PERFORMANCE RECORD ON FAMED "FLYING ACES"

ALTHOUGH these flying boats used by American Export Airlines have been engaged in 100% war work since 1942, they were originally custom-designed as luxury aircraft for transatlantic travel, and so included a carefully engineered cabin heating system with automatic Barber-Colman Controls. Since the first flight, these controls have been an integral part of the "Flying Aces", and have operated *well over 2000 hours without overhaul or maintenance.* To an airline this is a factor of major importance in maintaining schedules. Barber-Colman Controls further demonstrate their versatility and adaptability for aircraft use by the fact that, on a recent changeover from exhaust gas heat-exchangers to gasoline-fired heaters in the "Flying Aces", the *same controls will be used.* Automatic cabin temperature control is only one of a variety of functions which Barber-Colman aircraft control equipment can handle accurately and reliably with *maximum performance and a minimum of maintenance.* Barber-Colman Controls are light in weight, powerful, and specially designed for the extreme conditions of aircraft service. Barber-Colman Control Equipment has received the "Approved Quality Control Rating" of the U. S. Army Air Forces.

BARBER-COLMAN COMPANY
1245 ROCK STREET • ROCKFORD, ILLINOIS

Roland Rohlfs has been named Regional Adviser and Consultant on the promotion of private flying in the New York area of the Civil Aeronautics Administration.

Franz R. Steinbacher has rejoined the Faculty of the University of Michigan as Associate Professor.

Peter O. Tauson has been appointed Chief of the Technical Division of Frederic Flader, Inc.

Robert H. Wendt has resigned as Vice-President in Charge of Engineering at Taylorcraft Aviation Corporation and has been appointed Chief Engineer of the Globe Corporation, Aircraft Division.

John R. Weske, formerly Associate Professor of Aerodynamics at the Case School of Applied Science and recently on leave of absence to serve as Consultant to the General Engineering Laboratories of General Electric Company, has joined the Faculty of Rensselaer Polytechnic Institute as Professor of Aeronautical Engineering.

Edward Witek has returned to Consolidated Vultee Aircraft Corporation as Aeronautical Design Engineer.

Rear Adm. John H. Towers, U.S.N., who relieved Vice Admiral McCain as commander of the Second Carrier Task Force, Pacific 3rd Fleet (known as Task Force 38).

Members Elected

The following applicants for membership or applicants for change of previous grades have been admitted since the publication of the list in the last issue of the REVIEW.

Transferred to Associate Fellow Grade

Aument, Carroll M., Asst. Engineer, Sikorsky Aircraft Div., United Aircraft Corp.

Barfoot, Joseph Earl, B.S. in C.E.; Strength and Tests Engineer, El Segundo Plant, Douglas Aircraft Co., Inc.

Byers, Horace Robert, Sc.D. in Meteorology; Prof. of Meteorology, University of Chicago.

Cattaneo, Alfred G., Ph.D.; Research Engineer, Shell Development Co.

Chillson, Charles White, B.S. in Chemical & Mechanical Engineering; Chief Research Engineer, Propeller Div., Curtiss-Wright Corp.

Dutton, Donnell W., Prof. and Head of Dept. of Aeronautical Engineering, Georgia School of Technology.

Foa, Joseph Victor, Dr. of Engineering; Head of the Design Section, Research Lab., Curtiss-Wright Corp.

Gelbart, Abe, Ph.D.; Asst. Prof. of Mathematics & Aerodynamics, Syracuse University.

Gordon, Myron Boyd, M.E.; Vice-President in Charge of Operations, Fairchild Engine & Airplane Corp.

Kramer, C. Raymond, B.S.M.E.; Asst. Project Engineer, Republic Aviation Corp.

Maser, Ernest Eberhard, M.S.; Asst. Prof. in Charge of Aeronautical Engineering, Louisiana State University.

Newkirk, Burt Leroy, Ph.D.; Prof., Lecturer on Vibration Theory & Practice, Rensselaer Polytechnic Institute.

Sartore, Silvio Roland, B.S., M.E., Ae.E.; Chief Flight Test Engineer, Curtiss-Wright Corp.

Skramstad, Harold Kenneth, Ph.D.; Physicist, National Bureau of Standards.

Thomas, Harold William, B.S. in M.E.; Chief Experimental Test Pilot, Airplane Div., Curtiss-Wright Corp.

Elected to MEMBER Grade

Albright, Franklin Chester, B.S. in Ae.E.; Project Engineer, Consolidated Vultee Aircraft Corp.

Chen, Chi-Chien, B.S. in Ae.E.; Capt., Chinese Air Force.

Chien, Wei-Zang, Ph.D.; Research Engineer, California Institute of Technology.

Conea, Michael Mircea, Research Engineer, The Electric Furnace Co. Ltd. (England).

Dalton, George Michael, B.S. in Ae.E.; Chief Stress Engineer, Fleet Aircraft Ltd. (Canada).

Duncton, Percy John, B.S. in Physics; Technical Asst. (Aircraft Design), Vickers-Armstrongs Ltd. (England).

Geeslin, David Martin, B.S. of E.E.; Structural Engineer, Cessna Aircraft Co.

Hamilton, Dale Browne, Chief Design Engineer, Central Aircraft Corp.

Hampton, Ralph Desbro, B.A.; Senior Structural Design Engineer, Goodyear Aircraft Corp.

Hawkins, John Francis, Chief Draftsman, Fleet Aircraft Ltd. (Canada).

Hounsfield, Frank Robert Coupland, Chief Wind Tunnel Engineer, Handley Page Ltd. (England).

Ibrahim, Shukry Kamel, B. of Engineering; Lecturer, Faculty of Engineering, Fuad 1 University (Egypt).

Iyengar, Krishnagiri Thooppil Gopalakrishna, B. of M.E.; Technical Asst. to Chief Engineer, Hindustan Aircraft Ltd. (India).

Kossowski, Radoslaw Antony, Chief, Mechanical Section, Canadair Ltd. (Canada).

Livers, Carlos Benjamin, B.S. in M.E.; Chief Engineer, Aireon Manufacturing Co.

Loudon, Thomas Richardson, B.A. Sc.; Head of Dept. Civil Engineering, University of Toronto (Canada).

Morkovin, Vladimir, Ph.D.; Research Aerodynamicist, Bell Aircraft Corp.

Muftuoglu, Osman Saffet, M. in A.E.; Aerodynamicist, The Glenn L. Martin Co.

Mykytow, Walter Joseph, S.B. in A.E.; Aeronautical Engineer, Wright Field, A.U.S.

Page, Gordon Clarke, A.E.; Draftsman, Continental Aviation and Engineering Corp.

Peterson, Rudolph Earl, M.S. in Theoretical Applied Mechanics; Manager, Mechanics Dept., Westinghouse Electric Corp.

Petitjean, Alger Louis, Lt. Comdr., U.S Navy.

Redding, Arnold Hurxthal, B.S. in M.E.; Section Engineer, Flow Research Section, Westinghouse Electric Corp.

Reville, James Francis, B.S. in C.E.; Instructor in Aeronautical Engineering, Catholic University of America.

Rollo, John Curwen, Power Plant Engineer, Canadair Ltd. (Canada).

Sen, Sures Chandra, M.S.; Officer on Special Duty, Civil Aviation Directorate (India).

Wells, Obed Thomas, B.S. in Ae.E., & M.E.; Engineer, Preliminary Design, Structural Analysis, Cessna Aircraft Co.

Wiener, Bernard Andre, A.B.; Aeronautical Engineer, Douglas Aircraft Co., Inc.

Williams, Robert Lewis, B.S. in M.E.; Flight Test Equipment Engineer, Boeing Airplane Co.

Woodbury, Stephen Edward, S.B. in Physics; Asst. Project Engineer, Sperry Gyroscope Co., Inc.

Zietlow, John Forrest, Jr., B.S.; Asst. Section Chief of Labs., Bell Aircraft Corp.

Transferred to MEMBER Grade

Cassese, Salvatore, B.C.E.; Capt., Officer in Charge of Design, Operation and Maintenance, U.S. Army Air Forces.

Frantz, William, B.Ae.E.; Group Leader, Simmonds Aerocessories, Inc.

Kohr, Bradley George, Project Weight Engineer, McDonnell Aircraft Corp.

Lagerstrom, Paco Axel, Ph.D.; Research Aerodynamicist, Bell Aircraft Corp.

Lamson, Robert Tashian, B.S. in Chemistry; Experimental Test Pilot, Boeing Aircraft Co.

Mabrey, William Taylor, Staff Engineer, Pan American Airways System.

TOUGH PLANES AND TOUGH PILOTS NEED TOUGH SPARK PLUGS!

The Navy's great pilots loudly praise the tough fighting qualities of Grumman planes. Outstanding among them is the famous "Hellcat" more familiarly known as the "F6F." Needless to add the tough fighting qualities of the pilots themselves are the primary factor in the superb combat records they have compiled.

The combination has been unbeatable—the batting averages phenomenal. That's why we are proud indeed that Champion Spark Plugs have played their part in these ships, have been equal to fantastic extremes of service and dependable almost beyond belief.

The traditional dependability of Champion Spark Plugs has been put to every conceivable test in their unnumbered war assignments, bringing new prestige to their world-wide reputation. Today the Champions you buy for your plane are products of the same research and engineering, the same basic materials and manufacturing skill as those used in our most powerful military aircraft engines. Naturally they insure an extra measure of performance, economy and dependability in every engine. Champion Spark Plug Company, Toledo 1, Ohio.

DEPENDABLE

CHAMPION SPARK PLUGS

INSTALL CHAMPIONS AND FLY WITH CONFIDENCE

C26
Unshielded

Mack, Charles Edward, Jr., M.S.; Research Engineer, Grumman Aircraft Engineering Corp.

Meckley, William Oats, B.S. in M.E.; Application Engineer, Aviation Div., General Electric Co.

McIver, Robert Murdo, S.B. in Mining Engineering; Engineering Test Pilot, Cheyenne Flight Test Section, United Air Lines Transport Corp.

Murray, James Lore, Major, Supervisor of Maintenance, U.S. Army Air Forces.

Ostrand, Arnold Oestreicher, M.S.; Sr. Aircraft Stress Analyst, Otis Elevator Co.

Papadakos, Peter James, B.Ae.E.; Sr. Structures Engineer, Curtiss-Wright Corp.

Phillips, William Hewitt, S.M.; Head, Stability and Control Section, Flight Research Div., Langley Mem. Aero. Lab., N.A.C.A.

Reid, Andrew, Chief Inspector, Aircraft Div., Crown Can Co.

Reynolds, Eugene Joseph, B.S. in Ae.E.; Field Service Engineer, Boeing Airplane Co.

Rodgers, Oliver Eliot, Manager, Aviation Gas Turbine Design, Engineering Div., Westinghouse Electric Corp.

Shee, George Leo Wing, Sr. Service Engineer, Service Dept., Airplane Div., Curtiss-Wright Corp.

Stoner, Eliot Filger, M.E.; Chief Engineer, Preco, Inc.

Thompson, Donald McIntosh, B.Ae.E.; Capt., Project Officer, Pilotless Aircraft Branch, U.S. Army Air Forces (Wright Field).

Ziegler, Jean Leroy, Experimental Test Pilot, Airplane Div., Curtiss-Wright Corp.

Elected to Industrial Member Grade

Behar, Manoel Felix deMayo, Vice-President, Dir. Editor, Instruments Publishing Co.

Decker, Melvin LeRoy, Manager, Administrative Engineering, Goodyear Aircraft Corp.

Flaherty, Lester Allen, Asst. Chief Flight Engineer, Pan American World Airways.

Graves, Sherman Stockton, Head of Inspection and Quality Control, Cessna Aircraft Co.

Miller, Murray Lincoln, B.S. & M.A.; Asst. Chief Draftsman, Taylorcraft Aviation Corp.

Russell, Allan MacGillivray, A.B.; Vice-President, The Ohio Chemical & Mfg. Co.

Transferred to Industrial Member Grade

Coleman, James Cuthbert Barrington, Engineering Office, Canadair Ltd. (Canada).

Elected to Technical Member Grade

Barnes, Glen Fred, A.B.; Ground Training Supervisor, Africa Orient Div., Pan American World Airways.

Breslin, John Noel, Design Draughtsman, Scottish Aviation Ltd. (Scotland).

Chang, Kewi-Lien, B.S. in Ae.E.; Engineering Trainee, McDonnell Aircraft Corp.

Coar, Richard John, B.S. in M.E.; Asst. Project Engineer, Pratt & Whitney Aircraft Div., United Aircraft Corp.

Daniels, Frederick Russell, Technical Asst. (Aircraft Design), Vickers-Armstrongs Ltd. (England).

Davis, Neil Mose, B.S. in E.E.; Asst. Engineer, Continental-Denver Modification Center.

Friday, Charles Robert, Aeronautical Laboratory Technician, Langley Mem. Aero. Lab., N.A.C.A.

Harvey, Rex Anthony, B.Sc. in Engineering; Technical Asst. (Aircraft Design), Messrs. Vickers-Armstrongs Ltd. (England).

Jelenick, Michael Demetre, B.S. in A.E.; Jr. Research Engineer, National Research Council (Canada).

Kamath, Mundkur Vasudev, B.S. in Physics; Chief Inspection Supervisor, Hindustan Aircraft Ltd. (India).

Kantham, Kolipakam Lakshmi, Executive Div. Supervisor, Hindustan Aircraft Ltd. (India).

Kvarve, Archie Kenelm, B.A.; Test Engineer, The Glenn L. Martin-Nebraska Co.

Love, Charles Cooke, B.S. in M.E.; Stress Analyst "R," Douglas Aircraft Co., Inc.

Medford, Robert Donald, Lead Man, Airplane Div., Curtiss-Wright Corp.

Miskam, Frederick Charles, B.Ae.E.; Stress Analyst, Douglas Aircraft Co., Inc.

Morgan, Antony John Andrew, B.S. in M.E.; S 1/c, Naval Ordnance Test Station, Stress Analyst, Navy Dept.

Palermo, John Joseph, Group Leader, Simmonds Aerocessories, Inc.

Polivnick, Norton, B. in Architecture; Field Service Representative, Wichita Div., Boeing Aircraft Co.

Robeson, Albert John, Lecturer of Mechanical Engineering, Technical College (England).

Transferred from Student to Technical Member

Bonner, John Joseph, BAE.; Production Drafting, North American Aviation, Inc.

Buell, Donald Allen, S.B.; U.S. Navy.

Butler, Vincent Kingwell, Jr., B.S.; U.S. Navy.

Carroll, Francis Leonard, B.S.; U.S.N.R.

Dettwyler, Hans Rudolph, B.AE.E.; U.S. Navy.

Engle, Donald David, B.M.E.; U.S. Navy.

Faxon, David Kinyon, BAE; Jr. Liaison Engineer, Wright Aeronautical Corp.

Hearn, Danny Leroy, BAE; Midshipman, U.S. Navy.

Lesmez, Alvaro Vincent, BAE; Pvt., U.S. Army Air Forces.

Malcolm, Cesar Paradelo, M.Sc.; Capt., Argentine Air Corps (Argentina).

Pereira, Juan Charles, M.Ae.E.; Capt., Argentine Air Corps (Argentina).

Schultz, Kenneth Herman, B.S. in Ae.E.; U.S. Navy.

Elected to Affiliate Grade

Bulk, Harold Cornelius, A.B.; 1st. Lt., U.S. Army Air Forces.

Rush, Charles Robert, Mechanical Engineer; U.S. Army Air Forces.

von Herrmann, Charles Frederick, Jr., M.S. in M.E.; Capt., Priorities Officer, U.S. Army Ordnance Dept., War Dept.

Wylie, Eleanor (Miss), Qualified Draughtsman, The de Havilland Aircraft of Canada (Canada).

Necrology

Randall Noyes Chapman

Randall Noyes Chapman, Chief Engineer of Laister-Kauffmann Aircraft Corporation and a Technical Member of the Institute, was killed while test-flying a glider on August 12.

Mr. Chapman was born at Sioux Falls, S.D., on February 23, 1916, and received the Degree of Bachelor of Aeronautical Engineering from the Lawrence Institute of Technology in 1938. Prior to his connection with the Laister-Kauffmann Aircraft Corporation, he had been Head of the Aeronautical Engineering Department of the Lawrence Institute of Technology. He had been engaged in the development of intermediate and high-performance sailplanes since 1935 and held private and commercial glider-pilot certificates.

In 1936 and 1937 he served as a draftsman with the Aerocar Company of Detroit, working on the general and detailed design of commercial trailers, and from 1939 to 1940 he was Production Manager of the Midwest Sailplanes of Detroit, engaged in the design and construction of utility gliders and intermediate sailplanes.

Robert Hutchings Goddard

Robert Hutchings Goddard, an Associate Fellow of the Institute and Director of Research in the Bureau of Aeronautics of the Navy Department, died on August 10 at University Hospital in Baltimore, following an illness of about 8 weeks. Dr. Goddard was born in Worcester, Mass., on October 5, 1882, and received a Bachelor of Science Degree from Worcester Polytechnic Institute in 1908. He received a Master of Arts Degree in 1910 from Clark University and a Doctor of Philosophy Degree in 1911. For many years he served as Head of the Physics Department of Clark University, later taking a leave of absence to carry out rocket experiments for the Daniel and Florence Guggenheim Foundation.

Dr. Goddard was one of the pioneers in rocket propulsion and jet-propelled aircraft. He was engaged in this work at the time of the first World War and by 1919 had perfected a rocket reported to be able to rise to an altitude of 70 miles with a range of 200 miles. He de-

Nelson *Automatic* Stud Welding saves time and material!

Nelson Stud Welding saves time and material because it eliminates drilling holes and tapping to secure studs. In *less than a second* studs from ⅜" to ¾" diameter are secured. Automatic operation and accurate arc timing control produce complete fusion of the stud to metal. Operators are trained quickly and produce consistent results.

Thousands of stud welders are now used by more than 750 industrial plants and shipyards . . . because 500 to 1000 studs per operator can be secured per shift.

For rapid *precision* production of stud welded parts single and multiple stud welding units are available which weld one or more studs of various sizes at the rate of 20 to 30 welds per minute.

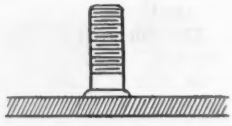
Write today for complete information on this time and material-saving equipment:

NELSON SPECIALTY
WELDING EQUIPMENT CORP.
Dept. 8, 440 Peralta Avenue
San Leandro, California

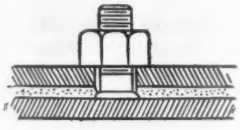
Eastern Representative: Camden Stud Welding Corp., 1416 South Sixth Street, Camden, N. J.

HOW NELSON STUDS
ELIMINATE DRILLING
AND TAPPING

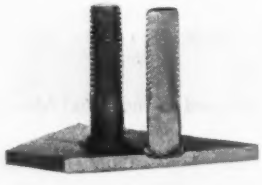
After layout and center-punching a stud is placed in the gun chuck. The pointed end is located in the punch mark and the trigger pulled. Instantly the arc flashes and the weld is made. The operator loads again and proceeds to the next weld.



Complete fusion between stud and metal results . . . drilling and tapping operations have been eliminated.



Cover and gasket fit easily and a neater result is obtained. One gun welds any diameter stud — a standard welding machine is used.



Cutaway of typical stud weld. Etched with Nital to show penetration.

signed and built a rocket powered by a turbine engine using liquid fuel, whose flight was stabilized and whose impetus was renewed in flight. He patented a device for stabilizing the flight of a rocket in 1932 and by 1935 he had it in practical use on rockets having a speed of 700 m.p.h. By 1938 he added 30 per cent to the range of his rocket. He was called to Washington to undertake Government work in 1942, and at the time of his death he was the chief of Navy research in the jet-propelled aircraft. His work was also applied to the development of the "Bazooka" and other rocket devices.

Corporal Charles Herman Krull

Corporal Charles Herman Krull, a Technical Member of the Institute, died in the service of his country on April 14, 1945. Before joining the Army, Corporal Krull had been an Aerodynamicist with McDonnell Aircraft Corporation. He was born in Defiance, Ohio, on January 26, 1922, and received a scholarship to Cornell University in 1940. He later attended Aeronautical University, from which he was graduated in 1943 with the degree of Bachelor of Science in Aeronautical Engineering.

Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Draftsmen—Experienced in the layout and detailing of mechanical devices for industrial and aircraft products. Excellent working conditions, convenient location. Address inquiries to Simmonds Aerocessories, Inc., and Simmonds Products, 30 Rockefeller Plaza, New York, N.Y.

Senior Layout Draftsmen, Junior Layout Draftsmen—Interesting high-speed jet aircraft project. Location New York City. Small organization. Opportunity for personal recognition. Send complete résumé or call or wire for interview. Postwar continuation. Address Dean C. Smith, Fairchild Engine and Airplane Corporation, 30 Rockefeller Plaza, New York 20, N.Y.

Detail and Layout Engineers, Stress Analysts, Aerodynamicists, and Design Engineers—For development work and production engineering work in Engineering Division. Must be citizens of the United States and have a certificate of availability. Call in person or write to Chief Administrative Engineer, Boeing Airplane Company, Wichita, Kan.

Radio, Electronic and Telephone Engineers, Electronic and Mechanical Draftsmen.—One of the largest manufacturers of a wide variety of electronic and communications equipment in the world is fully prepared and ready with an ambitious postwar program. Write to Personnel Manager, Federal Telephone & Radio Corp., 591 Broad Street, Newark, N.J.

Aeronautical Engineer—To teach Senior year subjects of aeronautical engineering course including design and stress analysis. Address inquiries to The Aeronautical University, Inc., 116 South Michigan Avenue, Chicago, Ill.

Aircraft—Chief of Structures. Eight years' experience. Write McDonnell Aircraft Corporation, St. Louis 1, Mo.

Aircraft—Chief of Weights. Five years' weight experience. Write McDonnell Aircraft Corporation, St. Louis 1, Mo.

Aerodynamicists, Stress Engineers, and Vibration Analysts. Needed for the Helicopter Division of Bell Aircraft Corp., Niagara Falls, New York. Write full details to R. A. Wolf, Chief Engineer, Helicopter Product Division.

Aeronautical Engineers, Senior Layout Draftsmen, Junior Layout Draftsmen. Experimental engineering unit working on new types of postwar airplanes. Seeking individuals interested in commercial field and who can produce without supervision. Location Roosevelt Field. Address Special Project C, Fairchild Engine and Airplane Corp., 30 Rockefeller Plaza, New York 20, N.Y.

Aeronautical Engineers—for immediate and urgent top priority work, the long-established Aeronca Aircraft Corporation seeks Project Engineers, Stress Analysts, Weight Engineers, and Layout Draftsmen. Since Aeronca's postwar plans are complete, with peacetime production in the offing, these positions offer unusual permanent opportunities for qualified men who can comply with W.M.C. requirements. Write in complete detail to Aeronca Aircraft Corporation, Box 00, Middletown, Ohio.

Aircraft Stress Engineers thoroughly familiar with the analysis of aircraft structures, aircraft controls, and all component parts for work on helicopters. Excellent opportunities for personnel interested in rotary-wing aircraft. Applicants must comply with W.M.C. regulations and be draft exempt. Apply by letter, giving references, to Administrative Engineer, Kellett Aircraft Corporation, Plant #2, Lansdowne Avenue above State Road, Upper Darby, Pa.

Personnel Needed—Executive and Administrative experience in manufacture of aircraft. Positions available in several fields; Factory and Production Management, Matériel, Tooling and Engineering. McDonnell Aircraft Corporation, Ambassador Building, St. Louis 1, Mo.

Aircraft Engineers—Experienced aerodynamicist; layout and detailed draftsmen; structural designers; senior drawing checkers; static test engineer; stress analysts; technical illustrators; technical writer. These positions immediately available in critical war work at attractive salaries. Postwar prospects excellent. Applicants must comply with W.M.C. regulations. Address replies giving education, experience, background, age and draft status to Personnel Manager, Edo Aircraft Corporation, Terminal Building, Flushing, N.Y.

Detail and Layout Draftsmen, Stress Analysts, and Design Engineers needed for development work in the Engineering Department. Must be citizen, not employed in essential war industry, or have a certificate of availability from the U.S. Employment Service Office or the War Manpower Commission of your area. Address inquiries to Curtiss-Wright Corporation, Airplane Division, Buffalo, N.Y.; Attention: Director of Engineering.

Aerodynamicist or Flight Test Engineer—Ability to analyze flight test data on advanced high performance aircraft. Submit qualifications to McDonnell Aircraft Corporation, Ambassador Building, St. Louis 1, Mo.

Associate Professor of Aircraft Structures—To teach senior and graduate courses in aircraft structural theory, develop structures laboratory and direct graduate structural work. Practical experience necessary. Advanced degrees preferred. Permanent position. Leading state university; Location—mid-west. Address inquiries to Box 340, Institute of the Aeronautical Sciences.

Associate or Full Professor—To teach advanced courses and direct research in the Aircraft Power Plant Design field. Recent experience in turbine and jet engine design and testing necessary. Advanced degrees preferred. Permanent position, large mid-western university. Can wait

from landing wheels to aileron skins— diversified jobs for magnesium

Cutting dead-weight is certainly magnesium's primary job in aircraft. Its ready adaptability to all common fabrication methods, however, is another advantage that makes magnesium attractive to manufacturers. How usefully this factor is serving the industry is indicated in the aircraft applications pictured here.

From the sturdiest shock resistant members to the finest surface finish . . . from landing wheels for heavy bombers to satin-smooth sheet covering ailerons on fighter aircraft . . . magnesium is constantly extending its widespread application in modern airplanes. ★ The landing wheels, cast in magnesium, make important use of the high strength of this light metal in a vital functional application. ★ The aileron skins, a distinct fabrication triumph, are thicker than aluminum sheet of equal weight, permitting machine countersinking, instead of dimpling, for flush rivets. The surface so achieved is completely smooth. ★ Extruded floor beams—25% stronger and 5% lighter when made of magnesium—are used for supporting floors in super-transports. ★ A major weight economy is attained in the 46-pound main landing gear pivots (cast by Century Metal Craft, Los Angeles) important among the many magnesium parts in American fighter planes. ★ Aircraft engine parts cast in magnesium help to reduce the weight-to-horsepower ratio. ★ Magnesium cover plates show how the lightest structural metal fits into the aircraft picture in the form of die castings. ★ Lightweight pedal-wells, formed and arc-welded from magnesium sheet, illustrate another magnesium fabrication advantage useful in aeronautical design. ★ And application continues to increase.

MAGNESIUM

THE METAL OF MOTION

MAGNESIUM DIVISION, THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland • Detroit • St. Louis • Chicago • Houston • San Francisco • Los Angeles • Seattle

six months if necessary. Address inquiries to Box 339, Institute of the Aeronautical Sciences.

Assistant to Associate Professor of Aerodynamics—Young man with Ph.D. to teach graduate courses in theoretical aerodynamics and direct theoretical and experimental research in this field. Research experience necessary. Position permanent. Mid-western state university. Address inquiries to Box 338, Institute of the Aeronautical Sciences.

Associate or Professor of Aerodynamics—To teach performance, control, stability and develop correlating flight test and flight instrumentation courses for large mid-western university. Position permanent. Practical experience necessary. Advanced degrees preferred. Address inquiries to Box 337, Institute of the Aeronautical Sciences.

Chief Engineer—To supervise an Engineering Department of 250 to 300 people working in a company doing aircraft design on prime contracts with the U.S. Navy. Applicant must have an engineering degree plus several years of background as Assistant Chief Engineer or better in an aircraft company of similar size. Must possess drive and initiative. Must be exceptionally strong on detail design. Incumbent will report to the Vice-President in Charge of Engineering. Salary between $10,000 and $13,000 per year. Address inquiries to Box 335, Institute of the Aeronautical Sciences.

Engineer—In charge of Experimental and Field Service Division of established aircraft company. Graduate engineer with good engineering background plus several years of experience as a supervisor of experimental manufacture. Applicant must be energetic with ability to perceive and follow-through problems typical of this type of manufacture. Must possess thorough knowledge of engineering and shop practices. Previous experience in the aircraft field working for a prime contractor considered absolutely essential. Salary $10,000 to $13,000 per year. Address inquiries to Box 334, Institute of the Aeronautical Sciences.

Aeronautical Cataloging Librarian. Experienced. Permanent position in New York City. Open October, 1945. Address inquiries to Box 330, Institute of the Aeronautical Sciences.

Aircraft Layout or Stress Engineer. Mid-west location. New aircraft designing. Write full particulars. Address inquiries to Box 329, Institute of the Aeronautical Sciences.

Engineer—To supervise manufacture of new airplane. Aeronautical background and heavy shop supervision experience absolutely essential. Good wages. Pleasant working conditions. Write all information in detail. Address inquiries to Box 328, Institute of the Aeronautical Sciences.

Aeronautical Engineer—With experience in structures and stress analysis and the writing of reports for submission to the Civil Aeronautics Administration. Address inquiries to Box 326, Institute of the Aeronautical Sciences.

Patent Engineer—Familiar with patent disclosures and procedures. Essential helicopter industry. Salary commensurate with experience and present earning capacity. Address inquiries to Box 322, Institute of the Aeronautical Sciences.

Electronic and Mechanical Engineers—Large radio corporation presently engaged in urgently needed war work for the armed forces needs engineering personnel in all categories. Sound peacetime future with an established leader in the field of Electronics. Located in East and mid-West. Write in detail. Address inquiries to Box 317, Institute of the Aeronautical Sciences.

Mechanical Engineer or Physicist—Not subject to draft, experience in product development, research, and testing. Must have sufficient mathematical background to perform calculations in stress and vibration analysis, thermodynamics, aerodynamics, and general mathematics upon own initiative. Some knowledge of combustion desirable. Wanted for research staff of well-established aircraft accessory company with good postwar prospects, located on the West Coast. Salary dependent on qualifications and experience. Address inquiries to Box 311, Institute of the Aeronautical Sciences.

Aeronautical Engineer, Chief of Structures, Stress Analysts—Excellent opportunity for qualified men with medium-sized aircraft manufacturer on postwar work. Commercial experience preferred but not necessary. Applicant must comply with W.M.C. regulations. Address inquiries to Box 309, Institute of the Aeronautical Sciences.

Instrument Designer—Medium-size industrial organization offers excellent opportunity. Position will pay top salary. Present and postwar possibilities are unusually attractive. Man must hold an Electrical or Mechanical Engineer Degree, and have knowledge of optics or electronics. He should also have at least four years' practical experience in instrument design. Please write in detail. Your reply will be held in strict confidence. W.M.C. regulations observed. Address inquiries to Box 304, Institute of the Aeronautical Sciences.

Stress Analysts and Aerodynamicists—Required for aircraft design work U.S. Naval Aircraft Prime Contractor. Address inquiries to Box 297, Institute of the Aeronautical Sciences.

Assistant Professor—To teach Mechanics, Strength of Materials, and Physics in a small Mid-western College. Must have Master of Science Degree, preferably in Engineering or Physics. Salary dependent on qualifications and experience. Position permanent. Address inquiries to Box 291, Institute of the Aeronautical Sciences.

Draftsmen—Four or five, wanted by large research and development organization; experienced in the layout of aircraft structural members. Four or five years' experience required; knowledge of stress analysis desired. Experience in wing or fuselage group would prove satisfactory. Address inquiries to Box 282, Institute of the Aeronautical Sciences.

Aerodynamics Engineer—Practical experience wanted by well-known long-established mid-west manufacturer to conduct technical research and market development in ventilating and air-cooling division. Attractive salary for man of ability and ambition. Address inquiries to Box 275, Institute of the Aeronautical Sciences.

Mechanical & Electronic Engineers—Large engineering firm engaged in essential work with growing backlog of postwar jobs needs engineering personnel in all categories: Designers, Layout & Detail Draftsmen, Checkers, etc. Location Manhattan. W.M.C. rules observed. Address inquiries to Box 263, Institute of the Aeronautical Sciences.

AVAILABLE

Engineer—B.Ae.E.; M.S. in M.E.; Ph.D.; Aeronautics major. Holds pilot's license and C.A.A. ratings to teach all phases of ground school. Prefers position in industry but will consider a university position with research and consulting possibilities. Location on west coast preferred but not a limitation. Address inquiries to Box 336, Institute of the Aeronautical Sciences.

Research and Development Engineer, B.S. in E.E.; M.S. in Ae.E. Three years' experience in propeller stress analysis, previous experience in electronic equipment and some experience in control mechanism design. W.M.C. compliance. Highest references. Must do essential work. Address inquiries to Box 333, Institute of the Aeronautical Sciences.

Graduate Aeronautical Engineer—Bachelor and Master of Aeronautical Engineering degrees from N.Y.U

Making a 40-ton shock "DISAPPEAR"!

When a Skymaster hits the runway, the tremendous landing energy of this huge plane quickly *"disappears"*. It's not an act of magic, but the shock-absorbing ability of Aerol landing gear that does the trick! . . . The remarkable stamina and efficiency of Aerols, which protect plane, crew, and cargo from landing shock, account for their universal acceptance for major types of aircraft. ◆ ◆ Our products, serving many industrial fields, are mentioned below. Whatever your needs, Cleveland Pneumatic engineers offer you the benefit of over 50 years manufacturing experience.

THE CLEVELAND PNEUMATIC TOOL CO., Cleveland 5, Ohio

Two and one-half years' engineering in aircraft manufacturing and 2½ years' engineering in air-line maintenance and operation. Recently completed engineering and economic studies on major postwar aircraft for air-line operation. Will receive Masters in Commerce and Finance in 2 years. Draft exempt and release available. Excellent references. Address inquiries to Box 332, Institute of the Aeronautical Sciences.

Aeronautical Engineering Student. Three years of college. Desires full-time engineering work, preferably in New York. Address inquiries to Box 331, Institute of the Aeronautical Sciences.

Service Engineer, B.S. in M.E.—Commercial pilot, licensed mechanic and navigator, also foreign licenses and international aviator's license. Fifteen years' aviation experience ranging from small flying service to foremost U.S. and foreign factories. Recent duties include: installation engineer, test pilot, service engineering, publications manager, asst. service manager of large engine factory. Spent last 2 years exploring sales possibilities in all Latin-American countries. Speaks French, Spanish, Dutch, German and understands Portuguese. Sees no further scope for improvement after 6 years with present employer and is interested in position with a future in progressive organization where his experience and abilities can be fully utilized. Address inquiries to Box 327, Institute of the Aeronautical Sciences.

Executive-Engineer-Test Pilot—World War II veteran with two years' recent supervisory experience in design and flight-testing for large commercial aviation corporation. Seven years of college engineering followed by five years of active duty as commanding officer of aircraft advanced-base, maintenance, repair, experimental, and operational units. Active experimental test pilot in service and during last two years in commercial aviation. Combat and test experience in over 50 different types of single and multi-engine land- and seaplanes. Recent experience in gas turbines and jet propulsion. War veteran status precludes any difficulty in leaving present position. Airline engineering and operation or manufacturer's flight research and design most desirable. Address inquiries to Box 324, Institute of the Aeronautical Sciences.

Airport Engineer—Five and a half years' experience as airport engineer. Responsible for site selection, layout, design, and inspection during construction of over 40 airports in eastern states. Experience also includes speaking before municipal governing bodies and local service clubs on frequent occasions. Registered professional engineer and have a student pilot's license, recently soloed. Desire connection as airport consultant with engineering company or airline. Particularly adapted to liaison work and promotion. Any location considered. W.M.C. compliance. Address inquiries to Box 323, Institute of the Aeronautical Sciences.

Stress Analyst, Design and Development Engineer—B.S. in Aeronautical Engineering and Engineering Mechanics, four years' experience in research, design, development and stress analysis pursuits with prominent aircraft concerns. One year on analysis and static test of pure monocoque wing. Two years as supervisor of group engaged in design and stress analysis of bombardment type airplane. One year with entire structural responsibility for extensive structural modification for large patrol type aircraft. Desires position with responsibility for structural design or stress analysis. Address inquiries to Box 321, Institute of the Aeronautical Sciences.

Aeronautical Engineer and Test Pilot with design, experimental engineering and flight experience desires suitable position doing development work or experimental engineering and/or flight testing. Available immediately. Address inquiries to Box 312, Institute of the Aeronautical Sciences.

Research Analyst and Technical Writer. Twenty-one years' experience, including Patent Law, Medicine, Aeronautics, and Internal Combustion Engineer, Liaison and Production Planning, including LPG. Several years in Engineering Department of Aircraft Manufacturer. Familiar with setting up technical records and systems. West Coast preferred. Address inquiries to Box 310, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Pilot—Graduate engineer over 15 years' experience in design, research, and manufacturing; eight years as experimental test pilot; eighteen years' flying experience. Desires position with company offering postwar future combining engineering and flying. Past employment includes several years as consulting engineer and chief engineer with large company. No objection to traveling. Address inquiries to Box 307, Institute of the Aeronautical Sciences.

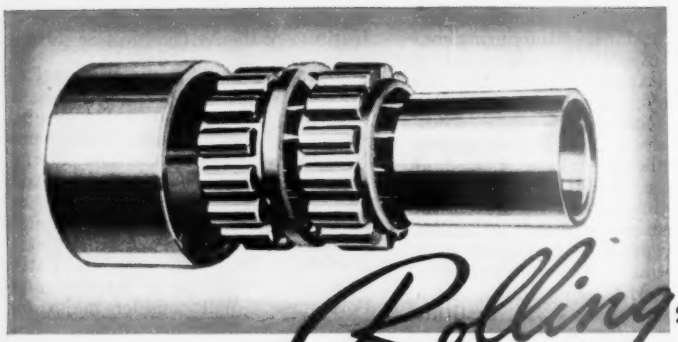
Sales and Service Engineering Executive, fifteen years' experience in airplane, engine and accessory design, service and sales, air-line maintenance engineering. Seeking position offering executive responsibilities organizing and directing sales and service activities or air-line maintenance engineering organization, either in this country or Latin America. Long residence in Latin America. Speak both Spanish and Portuguese. Will consider major oil company aviation department. Excellent references. Available for immediate employment. W.M.C. requirements complied with. Address inquiries to Box 305, Institute of the Aeronautical Sciences.

Engineer—Visualizer. Has broad experience in the application of industrial visual aids (graphic illustrations) to employee indoctrination, production, plant layout, tool design, methods, cost analysis, sales, and service manuals. Developed methods to prepare such drawings economically. Is prepared to act as consultant or accept contract for such work. Address inquiries to Box 302, Institute of the Aeronautical Sciences.

Industrial Designer—Stylist. Varied experience in product and interior design. Recently completed redesign of series of aircraft-engine test equipment. Desires additional clients for aircraft accessories styling or small plane interior styling. Address inquiries to Box 301, Institute of the Aeronautical Sciences.

Aeronautical Engineer and Consultant—Seventeen years in the aviation industry on military and commercial airplanes including development, design, administration and direction of engineering groups, company representative at Service procurement centers and engineering flight test experience. Desires a permanent and responsible position in engineering or engineering sales or as a technical representative in the aviation industry or allied field. Address inquiries to Box 294, Institute of the Aeronautical Sciences.

Research—Economic Planning and reporting work desired. Good background in aviation manufacturing industry, B.S. Degree in Economics, now working toward Masters Degree in Economics. Connection desired with aviation manufacturer or transport line. Address inquiries to Box 286, Institute of the Aeronautical Sciences.



Rolling, Rolling,

under the speeding train

Today, anti-friction bearings roll 'round and 'round on the journals of many railroad cars and diesel locomotives—speeding travel, smoothing rides and extending periods of trouble-free operation.

Carrying tons of weight at high speed, however, means wear, especially on the inner and outer races shown above, unless they are unusually and uniformly hard.

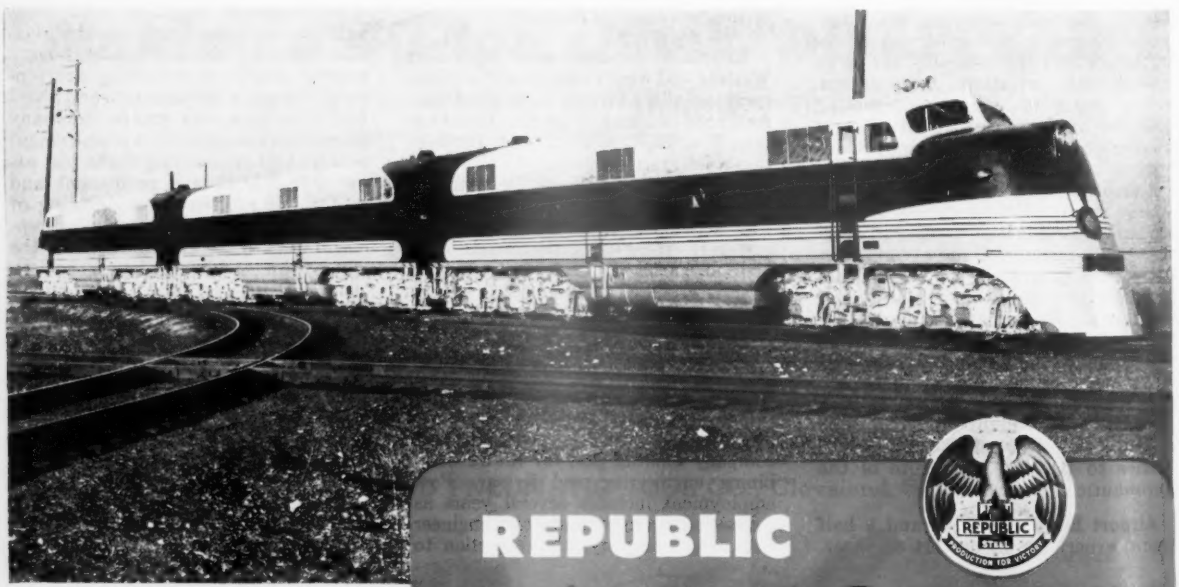
And UNIFORMLY hard they are—because they are made of electric furnace steel—a major part of which comes from Republic furnaces.

In electric furnace melting, steels can be "targeted" to hit narrow product and processing specifications with an unvarying exactness possible in no other method of steel-making. Thus response to hardening treatment and the resulting degree of hardness can be accurately predetermined, along with physical, chemical and mechanical properties. And such uniformity enables manufacturers to improve product quality and at the same time realize full benefits from mass production methods.

Republic Electric Furnace Steels are as CLEAN and SOUND as the most expert furnace practice can make them. They are free from small imperfections which, because they remain hidden until final inspection, cause the loss of many costly man- and machine-hours.

No matter what you make or intend to make after the war, there undoubtedly are parts which can be made better and cheaper with Republic Electric Furnace Steels. And Republic—world's leader in this field of steel-making—is ready NOW to help you use them to best advantage.

REPUBLIC STEEL CORPORATION
Alloy Steel Division • Massillon, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Bldg., New York 17, N. Y.



REPUBLIC
—Leader in the Production of
ELECTRIC FURNACE STEELS
"QUALITY" steels . . . alloy . . . stainless

I.A.S. Los Angeles Meeting

The Annual West Coast Meeting of the Institute was held this year as a local Los Angeles Section Meeting to comply with O.D.T. regulations regarding out-of-town attendance at meetings. The program for the two-day meeting, which was held at the Hollywood-Roosevelt Hotel on the afternoons and evenings of August 16 and 17, was arranged by the local Section Officers and Program Committee. Approximately 325 members and guests registered during the meeting.

The meeting was opened by the Chairman of the Program Committee, Philip A. Colman, Chief Aerodynamics Engineer, Lockheed Aircraft Corporation. L. Waite, Chief Technical Engineer, North American Aviation; Hall L. Hibbard, Vice-President and Chief Engineer, Lockheed Aircraft Corporation; John K. Northrop, President, Northrop Aircraft, Inc.; and Arthur E. Raymond, Vice-President of Engineering, Douglas Aircraft Company, Inc., acted as Chairmen of the various sessions.

The Chairman of the Los Angeles Section, Mr. Raymond, informed the members at the Thursday Evening Meeting of the proposed new local facility of the Institute. Mr. Raymond suggested that members examine the architect's drawings and plans of the building which were on display and discuss them with the Building Committee.

Charles H. Colvin, President of the Institute, was then introduced and told members and guests about the newly acquired building in New York. He also informed members that a committee was studying proposed changes in the Constitution and By-Laws of the Institute which would permit further expansion of activities.

Mr. Colvin; Bennett H. Horchler, Executive Vice-President; and Robert R. Dexter, Secretary of the Institute, were in Los Angeles to assist the officers of the Section and the Program Committee in making advance arrangements and in conducting the meeting. President Colvin also visited San Diego with Mr. Horchler and Mr. Dexter to discuss Institute plans for the future with specific reference to the San Diego Section activities and its proposed building.

The complete program of the meeting is given below and includes abstracts of the papers presented. All the papers will be considered by the Editorial Board for publication in the JOURNAL OF THE AERONAUTICAL SCIENCES and the AERONAUTICAL ENGINEERING REVIEW. A limited number of reprints of some of the papers are available for distribution to company libraries at a nominal charge of 25 cents each. Remittances should not be enclosed with orders since organizations will be billed for such reprints as may be supplied.

Thursday, August 16, 2 P.M.

Chairman: L. Waite

Chief Technical Engineer, North American Aviation, Inc.

Assistant Chairman: Walter Daniels, Jr.

Aerodynamics Department, North American Aviation, Inc.

Full Scale Power Plant Testing—M. U. Clauser, Power Plant Engineer, Douglas Aircraft Company, Inc.

With the increased engineering activity required due to the war, it was necessary to accomplish design work with inexperienced personnel. At the same time, it was necessary to cope with rapidly changing design requirements, many of which were unfamiliar even to experienced personnel. In order to gain this experience more rapidly in the power plant installation work, the Douglas Aircraft Company built and tested several full scale engine installations. This paper traces the development of these test installations and the results which were obtained.

The first installation was a ground test nacelle for the A-20 series airplanes. The severe cooling troubles later encountered on the airplane in flight were not anticipated from these ground tests, so the A-26 nacelle which followed was tested in the N.A.C.A. 16 ft. high speed wind tunnel at Langley Field. These tests and similar ones on the engine installation for the SB2D-1 airplane were of considerable value. The experience which had been obtained up to this time, however, was not considered to be widespread enough. The next nacelle installation was given extensive ground testing and the designers participated in the running of the tests and the analysis of the data. The caliber of the design engineers upon completion of these tests was such that the following airplane was designed almost without benefit of test of any kind. The flight test results on this airplane indicate that the experience of these men enabled them to do an outstanding engineering job of producing a simple and reliable power plant installation.

Armament for Jet-Propelled Bombardment Airplanes—R. A. Averitt, Armament Section, Aviation Division, General Electric Company.

The advent of jet propulsion engines for aircraft has so changed military airplane performance as to necessitate a completely new approach to the problem of accessory design.

In the case of bombardment airplanes powered by jet propulsion, the defensive armament reaches new importance. Not only is the general problem of defense more complex than in present conventional airplanes, but also the armament must contribute an absolute minimum of weight and drag to the airplane.

Although bombardment airplane defensive armament has undergone rapid and intensive development during recent years, the ultimate has by no means been reached. Continued research and development in all phases is required for successful armament application to jet-propelled airplanes. This development must be carefully integrated with the design of the airplane itself to the end that a wholly effective military tool—airplane and armament—will be obtained.

Glass Laminates and Their Application to Aircraft Structures—Captain George B. Rheinfrank, Jr., and Captain Wayne A. Norman, Engineering Division, Air Technical Service Command, Wright Field.

Aircraft designers have long recognized that before substantially improved performance can be obtained, the exterior surfaces of aircraft must be smoother and more stable. To achieve these objectives engineers of the Air Technical Service Command undertook the development of new materials and structural design using low pressure reinforced laminates. Research along these lines has resulted in a three-fold development in aircraft construction. A new basic structural material, a new low density core material, and new low pressure laminating resins, are combined in a greatly simplified sandwich type aircraft structure.

The new material, glass laminate (weighing the same as magnesium) is actually composed of 60 per cent glass fibers and 40 per cent bonding resin by weight. Unlike the common window glass which shatters easily, the glass cloth in the laminate is made of microscopic high strength filaments possessing entirely different physical properties.

The most significant result of this investigation came from the work on the BT-15 fuselage. Two types of glass sandwich fuselages were fabricated and tested. Both the glass-balsa sandwich and the all-glass sandwich fuselages on a strength-weight basis proved 50 per cent stronger than the standard metal fuselage. An all-glass sandwich wing is now under construction at the Air Technical Service Command and the ultimate goal of this development is an all-glass airplane.

The authors believe that the advent of this new basic material will eventually change present concepts of aircraft design and manufacture, and influence every phase of the aircraft field, including design, engineering, tooling, fabrication, and maintenance.

Thursday, August 16, 7:30 P.M.

Chairman: Hall L. Hibbard

Vice-President, Lockheed Aircraft Corporation

Assistant Chairman: Philip A. Colman

Chief Aerodynamics Engineer, Lockheed Aircraft Corporation

Research and the Army Air Forces—Brigadier General F. O. Carroll, Chief, Engineering Division, Air Technical Service Command, Wright Field.

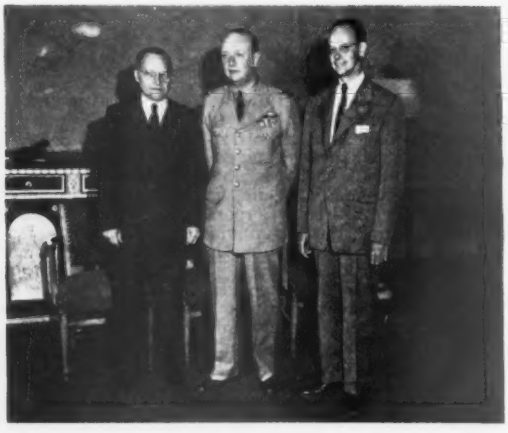
America has established itself as a formidable air power by turning her research reserves into the channels of production. The research preparedness of the peacetime years has provided the weapons with which the battle of Europe was won. Supplemented by intensified research, present weapons are being improved and new ones developed to finish the battle with Japan.

A study of German progress coupled with our own advancement shows that weapons may be developed which will be accurately usable against any point in the world. An almost unlimited expansion of technological development is indicated. Supersonic

Members and Guests at the I.A.S. Los Angeles Meeting

Left to right: James G. Ray, Vice-President, Southwest Airways Company; John K. Northrop, President, Northrop Aircraft, Inc.

Left to right: Col. W. Randolph Lovelace, II, Arthur E. Raymond, Clark B. Millikan, Professor of Aeronautics, California Institute of Technology.



Left to right: Charles H. Colvin, President of the Institute; Air Commodore F. K. Banks, Director of Engine Development, Ministry of Aircraft Production; Arthur E. Raymond, Vice-President of Engineering, Douglas Aircraft Company, Inc.

Left to right: Charles H. Colvin; Col. W. Randolph Lovelace, II, Aero Medical Laboratory, Engineering Division, Air Technical Service Command, Wright Field; Brig. Gen. L. C. Craigie, Chief, Engineering Division, Air Technical Service Command, Wright Field; Th. von Kármán, Director, Daniel Guggenheim Aeronautical Laboratory, California Institute of Technology.

Left to right: Charles H. Colvin; Hall L. Hibbard, Vice-President, Lockheed Aircraft Corporation; Arthur E. Raymond; Philip A. Colman, Chief Aerodynamics Engineer, Lockheed Aircraft Corporation.

speeds will be obtained, new sources of power will be developed, and radio and radar control will be realized.

The government working together with American Industry must provide this nation with the technological advancement to maintain a preponderance of strength in the air so that no enemy will dare to strike the first blow.

Structural Design Problems in the B-29 Airplane—George Snyder, Chief of Structural Design, Boeing Aircraft Company.

This paper presents a few of the considerations involved in the development of the structure for the B-29 airplane. The approach to the design of the wing, fuselage, tail surfaces, nacelles, landing gear, and certain miscellaneous details is discussed in terms of the influencing factors and design criteria as related to the airplane structural arrangement and operational requirements.

Although the basic structure of the airplane is not a radical departure from conventional structures, certain problems arose which, with their solutions, may be of interest.

Friday, August 17, 2 P.M.

Chairman: John K. Northrop

President, Northrop Aircraft, Inc.

Assistant Chairman: William R. Sears

Chief of Aerodynamics, Northrop Aircraft, Inc.

Icing Problems and the Thermal Anti-icing System—F. L. Boeke and R. A. Paselk, Heating and Ventilating Engineers, North American Aviation, Inc.

Ice formation has long been recognized as hazardous to the safety and performance of aircraft. Ice forms from water in the atmosphere, and occurs most frequently in clouds, fog or mist or during a temperature inversion. The three types of ice usually encountered are glaze ice, rime ice and frost. The formation of glaze ice and rime ice is mainly due to an evaporation process, but is aided by convection to the air and by conduction to the airfoil.

A number of methods of preventing and removing ice accumulations have been investigated. Tests conducted with the thermal type of anti-icing system, in which the surface temperature is increased by means of heated air circulated within the airfoil adjacent to the surface, have shown the thermal system to be more effective in combating ice. The thermal system should also be less detrimental to airplane performance, particularly at high speeds.

In the design of the thermal anti-icing system the number of variables to be considered usually required a lengthy analysis which, if the effect of the variables are not fully understood, may result in errors in heat required and unnecessary system weight. A study of the effect of altitude and air speed on the heat required, pressure available and pressure required, shows that the maximum heat transfer occurs at sea level at some air speed not necessarily the maximum for the airplane. This maximum design speed is influenced by the adiabatic heating effect. A further study shows that in designing the ducting system to provide the proper airflow conditions sea level and minimum air-speed conditions should generally be used. The design of the air passages or gap adjacent to the surface to be heated usually required a cut and try procedure. In this paper a chart is shown which readily evaluates the effect of varying the gap size and the supply air temperature on the surface temperature, weight flow or air required, and gap pressure drop. Additional charts provide a means of selecting the optimum combination of gap and supply duct system pressure drop which results in a system of minimum weight and maximum economy.

Landing Gear Strength Envelopes—J. F. McBrearty, Division Engineer, Structural Engineering, and D. C. Hill, Engineering Designer, Lockheed Aircraft Corporation.

A method for constructing diagrams illustrating the strength of landing gear structures is presented for various combinations of loads. The diagrams show graphically the maximum combinations of vertical-drag and vertical-side loads which a landing gear can sustain without failure. Strength diagrams for several different airplanes are presented and their significance discussed. The charts facilitate a comparison of landing gear strengths, are useful in determining the effect of physical changes to the gear structure and are helpful in the derivation of suitable ground load strength requirements.

Stability and Control in Helicopter Flight—James G. Ray, Vice-President, Southwest Airways Company.

This paper discusses some of the basic differences between piloting a helicopter and other vehicles, both air and ground. The helicopter has greater flexibility; its pilot is free to move in any direction, and can do so regardless of his heading at the time. This greater freedom of motion carries with it greater piloting responsibilities, a need for greater awareness of his relationship to everything in his vicinity and of any relative motion or change of motion.

The kind of control response needed for maneuvering with this greater freedom, the amount of vision necessary, the mechanical means of getting correct control, and the need for rapid variations in rotor thrust are discussed. The paper is semi-technical and treats the various control and stability problems of the helicopter from the pilot's viewpoint.

Friday, August 17, 7:30 P.M.

Chairman: Arthur E. Raymond

Vice-President—Engineering, Douglas Aircraft Company, Inc.

Assistant Chairman: E. H. Heinemann

Chief Engineer, Douglas Aircraft Company, Inc.

Aero-Medical Aspects of Cabin Pressurization for Military and Commercial Aircraft—Colonel W. Randolph Lovelace II, and Lt. Colonel A. P. Gagge, Aero Medical Laboratory, Engineering Division, Air Technical Service Command, Wright Field.

Whenever aircraft fly at high altitudes, for long periods of time and over long distances, the foremost design requirement for aircrew efficiency and passenger comfort is cabin pressurization. In military aircraft, cabin pressurization is used to eliminate completely the need for continuous use of oxygen, to prevent aeroembolism only, or simply to reduce the cabin to a level where use of pressure breathing is not required. In commercial aircraft, the health, comfort, and safety of the passengers are of prime consideration. In military aircraft, a significant hazard introduced by cabin pressurization is explosive decompression caused by structural failure of the cabin when under enemy gunfire. Criteria will be presented by which safe operating differentials may be chosen to minimize this hazard. The advantages of isobaric cabin altitudes below the now conventional 8,000-ft. level for military aircraft will be reviewed as they apply to passengers of commercial aircraft. Finally, emergency procedures necessary for crew and passenger safety in case of failure of the cabin pressurization system will be discussed.

Aerodynamic Design of Southern California Cooperative Wind Tunnel—Clark B. Millikan, Professor of Aeronautics, California Institute of Technology, and Norton B. Moore, Southern California Cooperative Wind Tunnel Staff.

An analysis is made of the design of the Southern California Cooperative Wind Tunnel. Balance equipment and auxiliary equipment are discussed. The following are considered in detail: basic design requirements, overall tunnel geometry, selection of working section geometry and dimensions, contraction ratio selection and contraction cone design, diffuser design, and corner vanes. High Mach Number tests were made of models of the contraction cone, the working design and the diffuser. The main drive, and the fan and the nacelle design together with prerotation vanes and straightening vanes, are also examined. The heat dissipation and turbulence suppression with regard to the design and location of cooling coils are given consideration, and the system of dehumidification used is explained. The general performance of the tunnel and the interrelationships of Mach Numbers and Reynolds Numbers from 1/4 to 4 atmospheres are discussed.

The power equipment and the recording and calculating equipment are described, as well as the auxiliary equipment, the instrumentation and the special shop equipment. Future additions to the tunnel are indicated.

MODEL 32

AIREX RELIEF VALVE

PATENT APPLIED FOR

ACTUAL SIZE

Designed to meet "AN" Requirements

1. NO COIL SPRINGS
2. COMPLETELY SILENT
3. ALL SEALS STATIC
4. SIMPLICITY OF CONSTRUCTION
5. SMALL SIZE
6. LIGHT WEIGHT

Flow capacity up to 12 G.P.M.

Pressure adjustable from 100 P.S.I. to 4000 P.S.I.

AIREX MANUFACTURING CO., INC.

5-33 48th AVENUE, LONG ISLAND CITY 1, N. Y.

Aircraft Research and Development . . . Hydraulic Equipment

Periodicals

Accessories and Equipment

Accessory Drive Equipment. J. A. Oates. A review of the design, fabrication, assembly, and testing of the Rotol universal gear box used for actuating aircraft accessories. Consideration is given to both the three-drive and six-drive types. Beginning with a description of the component parts of the gear boxes, the writer goes on to detail the facilities, equipment, and procedures employed in the manufacture of the bevel gears, main case, etc. Among the techniques reported are those for finishing the faces, gear cutting, gear checking, machining the bores, checking gear heights, subassembly, final assembly, testing, and conveying of materials and parts. *Aircraft Production*, July, 1945, pages 327–339, 30 illus.

Marshall Cabin Blower. The Marshall cabin blower for pressurized aircraft cabins is described. In addition to offering specific data about the design, features, purpose, and performance of this blower, the article contains some general information about aircraft pressurization. Problems involved in adapting the standard blower for employment in pressurizing are surveyed. *Flight*, June 14, 1945, pages 643, 644, 4 illus.

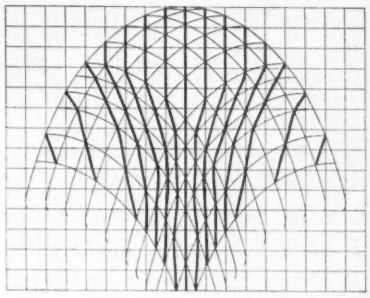
Ceramic Insulators for Sparking Plugs. Donald Turner. The requirements for internal-combustion engine spark plugs are discussed with particular reference to insulator materials. Developments and advances in spark-plug design and insulator materials are reviewed. Emphasis is placed on the importance of insulating materials having a high thermal conductivity which will permit better regulation of spark-plug temperatures. Information is given about sintered alumina, a new type of insulating material that is manufactured by Lodge Plugs, Ltd., under the trade name of Sintox. Temperature-resistance curves taken on sintered alumina insulators show the drop in electrical resistance produced by a heavy deposit of lead salts from antiknock fuel. The properties of Sintox, porcelain, and steatite are listed in tabular form. Photomicrographs of thin sections of Sintox insulators are also shown. *Engineering Materials*, June, 1945, pages 110–114, 4 illus.

Design of Hydraulic Systems. Part VII. Howard Field, Jr. In the seventh article of a series on hydraulic-system design, an analysis is made of basic power systems and their characteristics when used for intermittent and continuously loaded hydraulic systems. Unloader, full-pressure, variable-volume, and open-center power systems are discussed. Problems involved in some simple combinations of these systems are indicated. *Product Engineering*, July, 1945, pages 485–489, 11 illus.

Design of Aircraft Lubrication Systems. C. Stewart Brandt. This is the third and concluding installment of an article on various aspects of lubricating-system design. Engineering factors that are involved in flow control and hopper design are considered. The subject of oil foaming and its prevention is discussed. Information is given about typical cooler ducting systems and oil dilution systems for thinning the oil so that it will flow through the engine when starting at low temperatures. *Industrial Aviation*, July, 1945, pages 31, 32, 34, 35, 38, 93–96, 7 illus.

Aerodynamics

The Kármán-Tsien Pressure-Volume Relation in the Two-Dimensional Supersonic Flow of Compressible Fluids. N. Coburn. It is noted that Th. von Kármán and H. S. Tsien have treated the two-dimensional subsonic flow of a perfect, irrotational, compressible fluid by replacing the adiabatic pressure-volume curve by the tangent line drawn at an arbitrary point of this curve. The applicability of the Kármán-Tsien idea in the supersonic range is discussed. It is shown that, when the Kármán-Tsien relation can be used, the characteristics form a Tschebyscheff net (fish net). Consideration is given to the regions of the physical plane which can be mapped into a Tschebyscheff net in a unique one-to-one manner.



The Tschebyscheff net and the resulting streamlines obtained in a procedure for studying supersonic flow. By use of a protractor and other graphs, values can be determined at each point of the plane.

INDEX

Accessories and Equipment.... 57
Aerodynamics..... 57
Air Cargo..... 59
Air Power..... 59
Air Transport..... 61
Airplane Descriptions..... 63
Airports and Airfields..... 65
Armament..... 66
Avigation..... 66
Business and Finance..... 66
Civil Aviation..... 66
Companies..... 69
Design..... 69
Electrical Equipment..... 71
Engines..... 73
Flight Technique..... 73
Fuels..... 73
Gliding and Soaring..... 73
Hydraulics..... 73
Inspection..... 74
Instruments..... 74
Lubrication..... 75
Maintenance..... 75
Management..... 75
Marketing..... 77
Materials..... 77
Medicine..... 77
Metallurgy..... 79
Meteorology..... 79
Military Aviation..... 81
Naval Aviation..... 81
Paints and Coatings..... 81
Personalities..... 81
Personnel..... 81
Plastics and Plywood..... 81
Postwar Aviation..... 83
Private Flying..... 83
Production..... 83
Propellers..... 84
Radio..... 84
Reaction Propulsion..... 87
Research..... 87
Rotating Wing Aircraft..... 89
Stress Analysis..... 89
Superchargers..... 89
Testing..... 89
Tools and Equipment..... 89
Training..... 89
Warfare..... 91
Weight Control..... 91
Welding..... 91

Saves 90% checking time

Operates through CANNON PLUGS

This instrument is a development of the engineering department of the Lockheed Aircraft Corporation.

One man, with this electrical tester, checks the hundreds of circuits of a big bomber in 2½ hours—a job that formerly took four men 12 hours. One of the speed-up features of this time-saving instrument is the use of Cannon Connectors to make and break and change the many complex circuits employed.

Cannon Connectors are used because they are rugged, accurate and dependable. Such is their construction that they stand hard use—even abuse. They maintain perfect contact even after long and continuous service. The dependability and versatility of Cannon Plugs adapts them to scientifically critical circuits on many types of electrical instruments. Cannon Connectors are made in thousands of styles and sizes. No other connector can be had in so many variations.

Write for this bulletin on Type K Connectors—an extensive Cannon line used widely in aircraft equipment. The plug pictured is a Cannon 90° Type K. Address Department A-105, Cannon Electric Development Company, 3209 Humboldt Street, Los Angeles 31, California.

CANNON ELECTRIC

Cannon Electric Development Co.
Los Angeles 31, California

Canadian Factory and Engineering Office:
Cannon Electric Co., Ltd., Toronto, Canada

REPRESENTATIVES IN PRINCIPAL CITIES—CONSULT YOUR LOCAL TELEPHONE BOOK

The writer states that if the diagonal curves of the net of characteristics are drawn so as to correspond to equidistant values of the arc length parameter along the characteristics, then these diagonal curves will be the families of equipotentials and streamlines. Analytically, this last result means that the determination of the streamlines depends upon two arbitrary functions of one real variable. It is noted that the angle between the characteristics and the angle formed by a tangent to a streamline and the x-axis can be determined in terms of these functions. Further, the magnitude of the velocity and the density depend upon only the former angle and the Mach Number of the flow. In particular, if a known streamline coincides with the x-axis, it is shown that only one arbitrary function enters into the problem of determining the streamlines. Even in this case where the data are of a simple Dirichlet type (symmetric flow about the x-axis and a known external boundary streamline—as in the jet problem), the direct problem cannot be solved easily. An analytic-geometric method is outlined for solving the problem indirectly. Another proof of the fact that when the Kármán-Tsien relation is applicable the characteristics form a Tschebyscheff net is given in an appendix. *Quarterly of Applied Mathematics*, July, 1945, pages 106–116, 3 illus.

The Stream Function. Max M. Munk. A general discussion is given of the mathematical meaning and significance of the stream function of the velocity distribution of a moving fluid. The stream function is defined as a device for insuring the absence of divergence without the introduction of the divergence itself. The pronounced difference in the use of the stream function with two-dimensional and with three-dimensional problems is explained. Vector analysis is used to develop the theorem that is the parent relation for the general stream function. How two stream functions are geometrically related to the flow and its streamlines is shown, and this general definition leads to the common stream functions for the two-dimensional flow. As an example, the writer considers the flow of an ideal compressible fluid represented by a source point. *Aero Digest*, July 1, 1945, pages 117, 144.

Investigation of Some Aerodynamic Aspects of the Canard Airplane. Lester G. Kelso. A method is proposed for facilitating the investigation of the static longitudinal stability and trimming characteristics of the canard type of airplane. The writer suggests three simplifying steps, which are (1) neglecting the fuselage effect on stability and considering the so-called "skeleton" airplane consisting of only the wing and the horizontal stabilizing surfaces; (2) assuming the center of gravity to be located in the plane of the mean aerodynamic chord of the wing; and (3) neglecting the effect of the drag forces. With these assumptions, mathematical expressions are derived for calculating the moment coefficient for various values of lift coefficient and

decalage angle, from which curves can be plotted. These calculations show that the center of gravity must be located ahead of the aerodynamic center and that it must be at least 28 per cent ahead of the leading edges of the mean aerodynamic chord. It is stated that the designer can so proportion the surfaces that the stabilizer will stall before the wing, thus allowing the nose to drop before the main wing stalls and giving a "spinproof" design. Furthermore, the pilot's compartment can be located well ahead of the wing, improving the vision characteristics. *Aero Digest*, July 1, 1945, pages 72, 73, 3 illus.

Compressibility in Aerodynamics. William S. Beller. Stating that the theory of ballistics is unsatisfactory when applied to aeronautics, the writer holds that because of the simultaneous existence of subsonic and supersonic flows, the ballistic assumption of complete supersonic flow is invalid. With the aid of diagrams he explains the difference between compressible flow and incompressible flow, and outlines the application of the calculations worked out by von Kármán and Tsien to the solution of problems involving pressure distributions in the subsonic region. Drag is considered as a principal factor affecting supersonic airplane flight. An improvement in the procedure for calculating the drag coefficient is suggested. Other factors discussed are the effects of compressible flow, the wing moment, and the performance and stability of aircraft at high speeds. The need is emphasized for further research in connection with the use of a lenticular airfoil, an improved form of boundary-layer control, and the application of the theories of aerodynamics in the case of jet propulsion and rocket propulsion. *Industrial Aviation*, July, 1945, pages 40, 42–44, 46, 100, 101, 10 illus.

On the Stability of Two-Dimensional Parallel Flows. Part I. C. C. Lin. The writer attempts to answer these three questions for two-dimensional parallel flows: (1) Is a given flow (or a given class of flows) ultimately unsuitable for sufficiently large Reynolds Numbers? (2) What is the critical Reynolds Number at which stability begins? (3) What is the nature of the physical mechanism underlying the phenomena?

The study is divided into three parts. Part I deals with the general mathematical theory, with particular emphasis on clarifying the mathematical difficulties involved in the solution of the equation of stability. The present paper begins with a survey of the history of existing theories, reviewing briefly the work of other scientists and explaining the application of these theories to the present paper and the forthcoming Parts II and III. A general formulation of the problem is given, followed by the solution of the equation of Orr and Sommerfeld by methods of successive approximation. The analytic properties of the solutions are discussed and the writer proceeds to a study of the boundary-value problems. Numerous specific cases are considered and formulas are derived. *Quarterly of Applied Mathematics*, July, 1945, pages 117–142, 4 illus.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

Lofting Problems of Streamline Bodies. Part 24. Roy A. Liming in collaboration with Carter M. Hartley. The writers explain the use of the projective discriminant as a constant in reducing to a simple calculation exercise in linear algebra the establishment of the shoulder or control point in the fairing of a streamline shape. They emphasize the advantages of this simplified control over other systems and give a description of the application of analytic procedures based upon the projective discriminant. Formulas are derived for the coordinates of the control point in terms of the given coordinate data. The following specific advantages are noted: (1) Positive control over the radius of curvature conditions along the axis of longitudinal airflow; (2) complete three-dimensional control over the streamline shape for lofting and tooling developments; (3) maximum degree of simplicity in calculation procedures; (4) highly selective control over the type of contour in the body plan development; (5) minimum time required in the preliminary design stage of formulating the basic shape. *Aero Digest*, July 1, 1945, pages 74–76, 4 illus.

Air Cargo

Air Trade with the Americas. John B. Crane. An analysis is made of the potential air-cargo traffic between the United States and South America. Limitations of estimates made by the Bureau of Foreign and Domestic Commerce are pointed out and revised air-cargo potential figures are presented, based on certain new assumptions believed to approximate more nearly probable postwar traffic conditions. Among the factors considered are the assumptions that air-transport charges will average 15 per cent of the value of all shipments; air-cargo rates will range from 15 to 25 cents per ton-mile, with an average rate of 20.5 cents per ton-mile; and the average value per pound of potential air-cargo traffic to all South American countries will be $1.56. On the basis of such suppositions and at trade levels and prices equalling those of 1939, total potential air-cargo traffic between the United States and South America for a typical postwar year is estimated at 8,000 tons valued at $28,500,000. *Flying*, August, 1945, pages 44–46, 3 illus.

Speaking About Air Cargo. William A. Patterson. Various phases of air-cargo transport are discussed in this commentary by the President of United Air Lines. Air-mail service, the potentialities of air parcel post, air express and freight, and air-transport costs are considered. *Air Transportation*, July, 1945, pages 10, 12, 13, 48, 2 illus.

Air-Cargo Handling. Harry S. Pack. Some aspects of air-cargo handling are discussed, with particular reference to postwar improvements that will enable the air-line operator to reduce ground-handling time. Consideration is given to the effect of ground time on system speed, the type of materials that are handled, the development of terminals, mechanized loading operations and cargo tie-down methods, and other procedures that will insure faster, safer, and more economical loading operations. *Mechanical Engineering*, July, 1945, pages 463–467, 6 illus.

Air Power

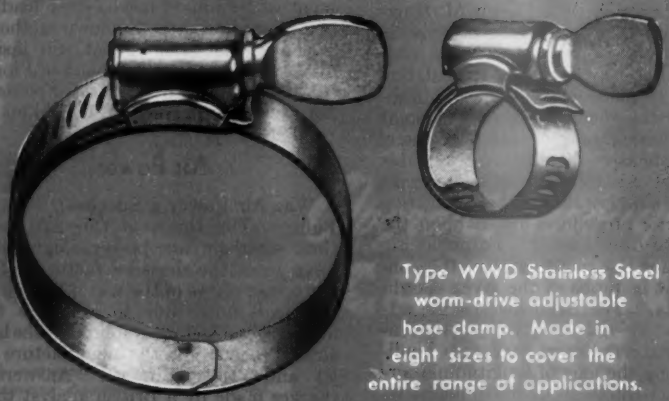
Was Air Power a Success? Curtis Fuller. The thesis of this article is that strategic air power might not have been the decisive factor in the European phase of the war if Germany had had more time to complete the underground factory system that she had already begun for the manufacture of jet and rocket aircraft. Answering charges made by a British analyst that air attack on enemy industrial centers was a military fiasco, the writer investigates the effects of the bombing campaign against Germany and evaluates it in terms of the entire war. He stresses the fact that strategic air power was effective only because of the time limits imposed upon the comparative technical advances of the contending powers. *Flying*, August, 1945, pages 21–23, 102, 106, 108, 110, 5 illus.

Lessons of the Air War. Part IV. Major F. A. de V. Robertson. Fourth of a series of articles reviewing the developments and changes that were evolved in the technique of air warfare to meet the exigencies of the European phase of World War II. Part IV is concerned with the employment of air power in support of, and in cooperation with, land forces. It tells how, with little exception, this phase of air power was neglected from the first World War through the beginning of the second. It describes how this mistake was rectified during the Middle East campaign with the establishment of air-and-ground cooperation combat techniques, the air part of which was carried out by the newly formed Tactical Air Forces. *Flight*, June 7, 1945, pages 616, 617, 3 illus.

Red Airpower—Today and Tomorrow. Lucien Zacharoff. An examination of the air-power concepts that were followed and applied by Russia in the Soviet campaigns against Germany. The writer states that co-

For Utmost Dependability...

WITTEK *Aviation* HOSE CLAMPS



Type WWD Stainless Steel worm-drive adjustable hose clamp. Made in eight sizes to cover the entire range of applications.

Type FBSS Stainless Steel hose clamp. The most widely used hose clamp in the aviation industry. Made in the standard AN 748 sizes . . . also additional sizes for special requirements.

Dependability has been recognized by the Wittek Manufacturing Company during its 25 years of hose clamp manufacturing experience as a foremost requirement in any hose clamp design. Wittek assures this dependability by the selection of basically sound designs . . . the use of high-grade materials and the application of good workmanship. Today Wittek offers two distinctly different hose clamp designs—each of which meets the requirements of Specification AN-FF-C-406 A.

TYPE WWD—an adjustable worm drive hose clamp made of stainless steel and designed to take full advantage of the superior physical properties of that material. Note the compact streamlined housing . . . the hardened one-piece thumbscrew—PLUS a new exclusive Wittek feature—an inner band of Stainless Steel accomplishing the two-fold purpose; (1) protecting the hose from the serrations in the outer band, and (2) distributing the load uniformally to provide greater strength and superior sealing characteristics.

TYPE FBSS—an improved Stainless Steel version of Wittek's basic FB design—now incorporating a bridge extender—in all sizes. This is the most effective hose clamp for all applications where an adjustable clamp is not necessary.

Hose Clamps for all requirements, made by Wittek—specialists in hose clamps and their applications.

ARMY E NAVY

War Bonds for Victory . . Buy More Than Ever Before!

WITTEK
MANUFACTURING CO.
4305-15 W. 24th Place, Chicago 23, Ill.

Aviation HOSE CLAMPS
WM Co.

ordination between air and surface forces is the key to Soviet war strategy and that close-support aviation was elevated on the eastern front to a level considerably higher than it ever enjoyed anywhere else. A review of various Russian aircraft indicates the means by which Russian doctrines of air strategy were carried out. *Air News*, July, 1945, pages 15–17, 58, 60, 10 illus.

The Threat of the Suicide Plane. Alexander Kiralfy. An evaluation of the Japanese "suicide" aerial technique and what it means in terms of air power. The nature of the planes used for suicide attacks, how these aircraft operate, and the reason for their employment are explained. Information is also given about the special assault formations of the suicide planes, the men who pilot them, the types of targets against which they operate, and the tactics of combatting them. Pictures of the suicide bomb are shown. *Flying Age*, August, 1945, pages 10–12, 65, 66, 13 illus.

Air Transport

A Ship Operator's View of Air Transport. Henry F. Grady. Eighth installment of a symposium on whether surface carriers should be permitted to participate in postwar air transportation. In this article the President of American President Lines states the advantages and feasibility of permitting steamship companies to utilize aircraft in their operations. Besides claiming that integration of air and water transportation would benefit aviation, the merchant marine, and the general public, he also states that if such a course is not undertaken the United States would be at a disadvantage in competing for postwar world markets against countries having a unified service. Interpretations of the law by the C.A.B. with regard to restricting steamship companies from participating in air transport are questioned, and the opinion is expressed that the whole matter of participation should be brought before Congress. *Aero Digest*, July 1, 1945, pages 42, 43, 158, 1 illus.

How Mexico is Girding for Tomorrow's Air Transport. A. A. Hartsinck. A report on the current status of air transport in Mexico. Statistics and facts are given about air routes now operating, air routes contemplated, the number of air miles covered, fares charged, equipment, and the business and financial connections of the companies. Factors of terrain, geography, economics, and inadequate train and bus facilities which make Mexico particularly adaptable to air transport are reviewed. Mexico's present air transport situation is likened to that of the United States in 1930, and the steps that are being taken by the Mexican Government to assure better civil aviation facilities for the future, greater stabilization of the economic side of air transport, and restriction of foreign capital and control are noted. Companies operating air routes in Mexico as of October, 1944, are listed, together with the number of kilometers of routes certificated for each. *Aviation*, July, 1945, pages 183, 184, 187, 270–274, 2 illus.

Feeders Must Be Different. Clarence M. Belinn. The requirements for a successful feeder line are discussed. It is stated that, in addition to providing service for existing traffic in a given area, the feeder line must cater to and generate a new class of business; that maximum service means not only frequency of flights but a tie-in with surface transport to speed passengers to their final destinations. Sections of the article discuss the independent, local feeder traffic potentials; route flexibility; rates and equipment; characteristics of the ideal feeder plane. *Air Transport*, July, 1945, pages 28–33, 6 illus.

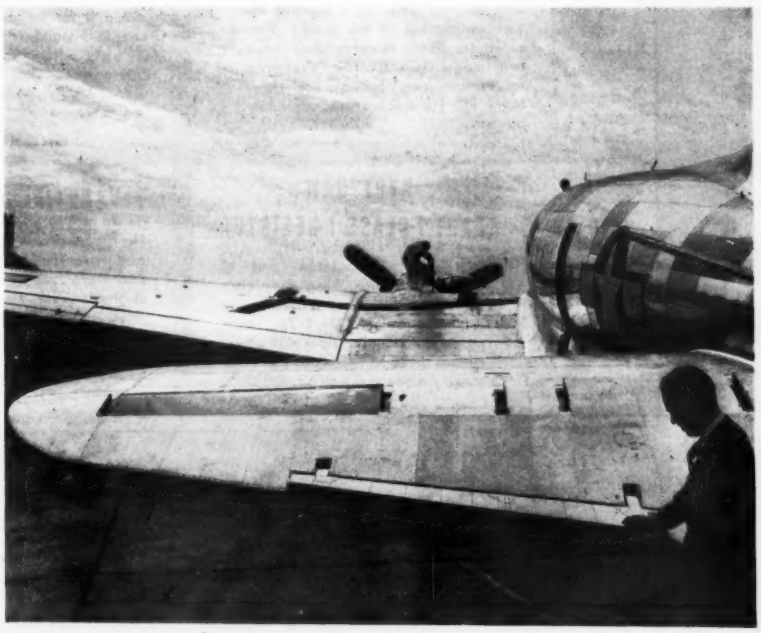
Who Says Locomotives Can't Fly? Dick Ross. A description is given of how 18 five-ton gasoline locomotives were transported in aircraft from Miami, Florida, to Burma. Speedy shipment was required because Lord Mountbatten's advances in Burma necessitated the expanded use of transportation equipment. *Air Transportation*, July, 1945, pages 7–9, 3 illus.

Military Aircraft Data Gives Overall Picture for Airlines in Market. Information is given about important types of transport aircraft now in everyday use by the Army Air Forces. Performance figures and other data about these aircraft are supplied in a table. The performance figures are based largely on information obtained in flight by the Air Technical Service Command, Wright Field. The information is intended for the use of those who will be "in the market" for transport types of aircraft after the war has ended. *American Aviation*, August 1, 1945, pages 75–77.

Airport Revenue From Feeder Airline Operations. John H. Frederick. Reporting that no provision has been made for airport expenses in any feeder-line application before the C.A.B., the writer warns that the supposition that no airport fees will have to be paid is an untenable one. He explains why estimates of future feeder-line operations should include airport charges. *Southern Flight*, July, 1945, page 48.

The Flying Public Has Its Say. Albert A. Arnhym. Replies to a questionnaire circulated by American Airlines are analyzed to indicate what the average air traveler expects in the way of postwar air-line transportation. It is reported that the public, willing to leave technical considerations to the experts, is mainly concerned with the speed, price, safety, and comfort of air transport. Specifications pertinent to these four factors are discussed. The writer tells what speeds are desired, what price ranges are expected, what particular items constitute the requirements for comfort, and what prejudices have to be overcome by safety devices. *Aero Digest*, July 15, 1945, pages 44, 45, 124, 126, 2 illus.

What an Airline Buys. H. D. Wigley. The purchasing agent for Delta Airlines gives an account of what it takes in the way of cash to operate an air line, and where the cash goes. A single month's purchases are listed in a table, which gives items purchased locally, items purchased from the manu-



The Curtiss V-tab permits trimming the aircraft readily while in flight, to compensate for passenger movement within the cabin; it also simplifies the load-balancing operation.

YOUR CHECK LIST OF NEW IRC PRODUCTS

To a line of resistors already broader than that of any other manufacturer in the entire resistor industry, IRC has, in the last few months, announced several new and important contributions. Among the newer developments having wide-spread application in the electronics field are the components here briefly reviewed. All of these products are available in reasonable quantities except the Type BTR Resistor, which is still wholly allocated to a special war project. However, samples of this unit are available and will be gladly sent for test or experimental purposes. Your inquiries will receive prompt and welcome attention.

TYPE PRT POWER RHEOSTAT

Rugged yet light in weight and of neat appearance the PRT conforms fully with AN3155 specs. Has heavy screw type terminals at rear of enclosed all-metal housing. Available in 25 and 50 watt models.

TYPE BTA 1 WATT METALLIZED INSULATED RESISTOR

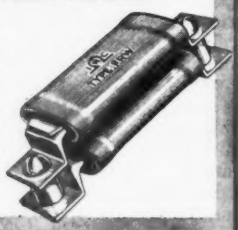
Pencil-thin, less than ¾" in length and conservatively rated at one watt the BTA is a quality resistor throughout and meets RC30 specs. Low in operating temperature it has proportionately high wattage dissipation.

TYPE BTR ⅓ WATT METALLIZED INSULATED RESISTOR

Scarcely bigger than a bump on a wire (L. 13/32"-Dia. 3/32") the BTR ⅓-watt resistor has all the quality characteristics and features that have long made IRC's BT line "Preferred for Performance." Suitable for Army-Navy RC 10 applications. *Available postwar.*

TYPE FRW FLAT WIRE WOUND RESISTOR

Efficient as a tubular wire wound, the type FRW has many features that recommend it for limited space use. In 5 standard sizes to comply with JAN-R-26, specs for RW 20, RW 21, RW 22, RW 24 requirements.



TYPE GRW GRADE 1-CLASS 1 RESISTOR

Thoroughly dependable and of sound construction these completely sealed units meet or surpass every requirement of JAN-R-26 specs. Made in 7 standard sizes with power ratings of 15 to 140 watts and resistance ranges of 0.1 to 63,000 ohms.

FINGERTIP CONTROL

No bigger round than a nickel and wafer-thin, this control will find many useful applications in the smaller electronic devices. All-inclusive design eliminates the usual knob, shaft and bushing without impairing functional operation.

For more complete, technical information on any of the above IRC products write to Dept. 17-I

INTERNATIONAL RESISTANCE CO.

401 N. BROAD STREET · PHILADELPHIA 8, PA.

PREFERRED FOR PERFORMANCE · IRC · FIXED & VARIABLE RESISTORS ·

IRC makes more types of resistance units, in more shapes, for more applications, than any other manufacturer in the world.

facturer, and service items purchased. *Air Transport*, July, 1945, pages 34–39, 6 illus.

Let's Have Feeder Airlines Now. Part IV. James G. Ray. The concluding article in a series on various phases of feeder air-line establishment and operation summarizes the need for feeder air lines in the United States and advocates the separation of local and long-haul traffic in air transport. Justification for a national system of feeder lines is based on factors of adequate air transportation, postwar employment, and national security. The reasons given for independent feeder-line operation support the theory that the business can be best promoted and developed by an organization whose primary purpose is the operation of feeder-line transport, since, if the feeder line were to be run by a company operating a long-haul or trunk-line service, feeder-line operations would be relegated to second place in favor of the more complex and remunerative operations. *Aviation*, July, 1945, pages 109–111.

Plane Sense and Bush Flying. A serial article analyzes the potentialities, costs, rates, and revenues of an air-transport operation in the northwestern part of Canada. The first section investigates the possibilities for such a business, the most promising regions for it, and the type of service that is required; it then goes on to discuss the kind of equipment that would be most efficient for such a service. The costs of maintaining the equipment, the rate of depreciation, and the volume of business which must be obtained to make operation of the equipment profitable are considered. The need for, and possibilities of, subsidies to such a service are mentioned.

A guiding cost-and-revenue formula for "bush" flying is set up. This covers aircraft efficiency, costs, revenue, and work estimates. *Canadian Aviation*, July, 1945, pages 36–39, 68, 73, 9 illus.

Long Range Flight Crews. Charles Mattingly. The writer offers arguments in support of his statement that it is false economy to reduce the flight crew for long overwater flights below a five-man minimum except in cases of emergency. The minimum personnel deemed necessary for such trips are captain, copilot, navigator, radio operator, and flight engineer. *Flying*, August, 1945, pages 71, 72, 138, 140, 3 illus.

The Flying-Boat and the Future. Capt. H. L. Fry. A flying-boat captain discusses the suitability of this type of aircraft for postwar transport tasks. He points out the advantages of certain types of flying boat for these tasks and urges that the operation of flying boats on some important routes be continued. *Aeronautics*, July, 1945, pages 42–47, 7 illus.

Factor "X." "Cicero." An investigation of three problems that will affect the large-scale use of postwar international air transport. These problems concern complex customs, passport, and medical-examination situations in connection with air travel. It is shown that unless efficient and special practices are developed for carrying out passport, customs, and medical regulations, these three factors will seriously mitigate against air passengers' convenience. *The Aeroplane*, June 15, 1945, page 692.

Airplane Descriptions

The Improved Norseman Mark V Still Masefield's Choice. Complete specifications are given for the wheel, float, and ski versions of the postwar commercial Norseman V transport aircraft. This plane is reported to be basically the same as the Noorduyn-manufactured U.S.A.A.F. C-66A, but with certain indicated modifications and with greater pay-load capacity because of the elimination of special military equipment and features. Particulars are summarized under the following headings: fuel system, oil system, heating system, accommodations, radio provisions, power plant, standard equipment, extra equipment, alternative equipment, and descriptive data (the latter including information pertinent to dimensions, loadings, and construction). Two tables contain figures representing the performance, weights, and loads of this aircraft. *Commercial Aviation*, June, 1945, pages 30–33, 7 illus.

Bristol Aeroplane Company Developments. Part I. Some developments that are being carried out by the Bristol Aeroplane Company, Ltd., are described by the writer, following a visit to the Filton works. Particulars are given about the design and preliminary construction of the Brabazon Type 1 transatlantic air liner, which has a designed still-air range of 5,000 miles and an economical cruising speed of 250 m.p.h. The principal dimensions of this aircraft are listed. The span is 230 ft., length 177 ft., and the height over the rudder 52 ft. It will be powered by eight Bristol Centaurus 2,500-hp. radial engines. The important specifications of these engines are listed and features of their design are discussed. *The Engineer*, July 6, 1945, pages 12, 13, 3 illus.

Planes of the Great War. A compendium of data on aircraft used during the first World War. The airplanes mentioned include British, French, and German planes. Drawings illustrate several of the planes. *Air News*, August, 1945, pages 27, 28, 31, 32, 23 illus.

The Avro Tudor I. A study of the design, construction, and performance characteristics of a British postwar long-range luxury air liner. Designed to carry twelve passengers, the four-engined Avro XX (or Tudor I) has a pressurized fuselage and can operate efficiently at an altitude of 25,000 ft. Its span is 120 ft.; its maximum range about 4,100 to 4,890 miles (varying with certain controlling factors); and its maximum speed about 242 to 346 m.p.h. (likewise dependent upon certain controlling factors). In its survey of the Tudor I, this article stresses details of the tail diaphragm, bulkhead, wing layout, passenger and crew accommodations, and the pressure system. Tables of performance and design data are included. A diagrammatic drawing of the aircraft illustrates its layout and features. *Flight*, June 28, 1945, pages 690–695, 6 illus.; *The Engineer*, July 6, 1945, page 18, 1 illus.

Blackburn Retractable Hull Flying-Boat. This article contains particulars about the design, engineering, construction, and performance of the Blackburn B.20. Completed and tested in 1940, the B.20 incorporates the patented feature of a planing bottom that is retractable. This planing-bottom portion of the hull is separated from the main section, on which it is mounted, by means of a set of links. The links are so proportioned that in the lower position the hull and mainplane assume the best attitude for take-off, while in the retracted position the planing bottom or pontoon fits snugly to the hull in streamline contours.

The aircraft itself is noted to be a medium-sized, general purpose, high-wing, cantilever monoplane flying boat of all-metal construction, with twin engines carried in nacelles mounted on the leading edges. Attention is called especially to details of its hull, pontoon, mainplanes, and internal arrangement. Specifications are tabulated. *The Aeroplane*, June 22, 1945, pages 714, 715, 3 illus.

Wide Use of Magnesium Featured in New Spartan Executive '12.' Details are given about a new Spartan Executive airplane, designated as the Model 12, which is under construction at the plant of the Spartan Aircraft Company. It is stated that, externally, this model is hardly distinguishable from the prewar model 7W, except for its tricycle landing gear. Internally, however, it incorporates many new features, both in construction and equipment, which will reduce the empty weight from 2,987 to 2,790 lbs., increase the design gross weight from 4,400 to 4,700 lbs., and increase the cruising speed to 203 m.p.h. Outstanding among the changes will be a switch to stressed-skin design for the wing and empennage, and a liberal use of magnesium. *American Aviation*, July 15, 1945, page 80, 3 illus.

The Langley. Leighton Collins. A review of the operational and performance characteristics of the Langley twin-engined aircraft, produced in 1941. In discussing the qualities of this plane and how it flies, the writer claims that it favorably demonstrates the feasibility of a low-powered 3- to 4-place conventional airplane with twin engines. *Air Facts*, August, 1945, pages 54–68, 3 illus.

Electro-Mechanical Actuation of Airplane Controls

Lear, Incorporated is one of the leading manufacturers of electro-mechanical control mechanisms. Its actuation and control systems have thus far served in over 750 applications on warplanes.

Lear produces parts and components which do the complete job—from converting electricity taken from the airplane's circuits to actual movement of controls, wing surfaces, landing gears and doors. Listed here are some of the applications served by Lear equipment.

Among the planes using Lear designed and produced electro-mechanical actuating mechanisms are:

BELL: B-29 (Superfortress), P-63 (Kingcobra), XP-77 • **BOEING:** AT-15 (Crewmaker), B-29 (Superfortress), XB-39, C-97 (Stratocruiser), XPBB-1 (Sea Ranger) • **BUDD:** RB-1 (Conestoga) • **CONSOLIDATED:** B-24 (Liberator), B-32 (Dominator), C-87 (Liberator Express), LB-30, PB2Y-3 (Coronado), PB4Y-2 (Privateer), RY-3, TBY (Seawolf), Model 39 • **CURTISS-WRIGHT:** C-46 (Commando), XP-55 (Ascender) • **DOUGLAS:** XB-19A • **EASTERN:** TBM (Avenger) • **FAIRCHILD:** AT-21 (Gunner), C-82 (Packet) • **FORD:** B-24 (Liberator) • **GENERAL MOTORS:** P-75 (Eagle) • **GOODYEAR:** F2G • **GRUMMAN:** F6F (Hellcat), F7F (Tiger Cat), F8F (Bearcat), TBF (Avenger) • **LOCKHEED:** P2V (Ventura), P-80 (Shooting Star) • **MARTIN:** BTM, B-29 (Superfortress), JRM-2 (Mars), PBM-5 (Mariner) • **NORTH AMERICAN:** B-24 (Liberator), C-82 (Packet) • **NORTHROP:** P-61 (Black Widow) • **REPUBLIC:** P-47 (Thunderbolt).

LEAR, Incorporated

Address all inquiries to: Home Office, Piqua, Ohio. Plants at Piqua, Ohio and Grand Rapids, Mich. West Coast Subsidiary: Lear, Inc. of Calif., Los Angeles, Calif. Research and Development: New York, N. Y.

Lear INCORPORATED

Collapsible "turtleback" of the Curtiss SB2C Helldiver. The turtleback structure is aft of the gunner's cockpit and, when retracted, increases the gunner's field of fire. It is actuated by a separate hydraulic system, including a manual pump operated by the gunner, a hydraulic strut, a reservoir, and a dump valve.

New Aircraft Types. Some brief information is given concerning several British aircraft types. One, the Westland Welkin, is a new high-altitude, single-seater fighter powered by two Rolls-Royce Merlin engines. The others, new versions of existing types, are the Short Sunderland Mark V, powered by four Pratt and Whitney engines of the R-1830 type; the Handley Page Halifax VI, having four Bristol Hercules engines of 1,800 hp. each; and the Vickers-Armstrongs Warwick V, a general reconnaissance bomber with two Bristol Centaurus VII engines of more than 2,500 hp. each. *Flight*, June 21, 1945, page 664.

Aero Commander Is New Light Transport. The Commander L-3804, a projected design for a charter feeder-line type of aircraft, is described. Now in the process of construction by the Aero Design & Engineering Corporation, this airplane is reported to be a cantilever high-wing monoplane powered by two 190-hp. Lycoming six-cylinder engines. It is expected to seat five or six occupants and to sell for $12,500 and up, depending on interior furnishings and equipment. A top speed of 181 m.p.h. at sea level, a service ceiling of 24,400 ft., and a range of about 700 miles are planned. Specifications are included with the descriptive data given in the article. *Aviation*, July, 1945, pages 163, 164, 2 illus.

The Westland "Welkin" Fighter. Details are given about the Westland Welkin, a British high-altitude single-seater fighter designed to combat the menace of the high-flying raider. It is provided with an armored pressure cabin and four cannon. The wing span is 70 ft. Power is supplied by two Rolls-Royce Merlin engines. To prevent ice formation on the windshield, warm air is pumped between the double layers of glazing forming the pressure-resisting surface of the pilot's enclosure. *The Engineer*, July 6, 1945, page 17, 2 illus.

Airports and Airfields

Airplane Performance and Airport Design. Part III. Frederick K. Teichmann. Continuation of a study in which the basic factors of airplane performance are examined to indicate their effect upon the location and design of an airport. This article is concerned with the direct bearing of contact speeds and landing runs on airplane and airport design. It also explains variations in the landing load factor and the figures that the airport designer must take into consideration when planning the facilities to allow for the stresses imposed on the pavement in landing the types of aircraft expected to use them. *Airports*, July, 1945, pages 30, 31, 5 illus.

Airport Planning for Private Flying. Part II. The second article in a series containing advice about the practical steps to be taken in the construction and development of Class I and Class II airports for private flying discusses layout, grading, and drainage. It contains specific suggestions for developing these three phases of a smaller airport, telling how plans can be made at the inception of the airfield for the progressive provision of those three factors as the airport's operations increase. A table listing recommended minimum standards for Class I and Class II airports is included in the article. *Southern Flight*, July, 1945, pages 46, 47, 59, 2 illus.

Building Types Study No. 100 . . . Airports. The major part of a special Building Types Study issue of *Architectural Record* is devoted to airports. The study was carried out in collaboration with the magazine *Aero Digest*. Greater emphasis is placed on overall planning and on service to people and communities, than on facilities for servicing planes. Several of the articles include plans and sketches of existing and suggested airports, and building construction details.

The articles are as follows: "What Is Meant by Air Traffic Control," by Julian Whittlesey; "Ports Being Reclassified by Purpose"; "Runway Designs Still in Evolution"; "10 Year Planning for Private Ports," by Julian Whittlesey; "Twin Cities' Model Regional Airport Authority"; "Designing the Large Terminal," by Albert F. Heino; "San Antonio Municipal Airport," by Atlee B. and Robert M. Ayres; "Westchester Airport"; "Research Airport Project"; ATC Airport Details," by Charles M. Goodman; "Temporary Construction Methods," by Charles M. Goodman; "Postwar Scheme for Lockheed Air Terminal," by J. E. Dolena; "Airport Profits Prove Value of Extra Facilities," by Don Taylor. *Architectural Record*, April, 1945, pages 66–106, 63 illus.

Cherchez La Airport. John Abiuso. A system of air-route marking is suggested. This system is based upon the use of "slat construction" elevated markers, which are described and illustrated. The recommended markings include an arrow pointing north, the name of the state, and a figure and number indicating location according to a system now used on road maps. In explaining the construction of the wooden markers and the method by which they are erected, the writer stresses the fact that these markers are always visible even under conditions of snowfall or drifting sand. *Aviation*, July, 1945, pages 173–175, 7 illus.

Are Airports Classified Properly? J. Kirk Baldwin. It is proposed that the present C.A.A. method of classifying airports by length of runways be abandoned in favor of a system whereby the airport would be classified on the basis of facilities and accommodations, in addition to runway length. A corollary suggestion is for the reversal of the labelling method, so that major airports would be placed in the Class I bracket and smaller airports in the higher numerical classifications, instead of the other way around. *Airports*, July, 1945, pages 28, 42, 4 illus.

High Speed Fuel Pump Cuts Service Time. Particulars in this article pertain to the construction, operation, and advantages of a power unit for quick refueling of aircraft. A product of the Van Vleck Manufacturing Company, this unit is mounted in a truck

or trailer. It consists essentially of four described assemblies: (1) throw-in and brake lever mechanism; (2) pump-speed governor; (3) speed set-up transmission; and (4) the pumping units, of which there are two, each with a capacity of 150 gal. per min. *Aviation*, July, 1945, pages 188, 189, 5 illus.

Dispersal of Fog on Airfields. Part III. In the third installment of a continued article about the "Fido" system of fog dispersal, the development of an intersecting runway burner is described. Experiments with the Haigill burner for use along the main runways of airfields are discussed. Particulars are given regarding the development of the "slot" burner, so named because it is housed in a trough which runs the whole length of the installation and is covered by a steel grid strong enough to allow aircraft to run across it. Other sections discuss the pumping plant and installation work. *The Engineer*, June 22, 1945, pages 486, 487, 4 illus.

Design and Location of Structures for the Modern Airport. Part II. Hervey F. Law. One of a series of articles presenting the major factors involved in the planning, design, and construction of the many types of landing facilities that will be required for postwar flying. This particular article is concerned with airport structures and contains pertinent suggestions regarding the provision for and arrangement of terminal buildings, facilities for passengers' comfort and amusement, airport traffic-control tower, plane parking aprons around the terminal building and along the hangar line, gates and ramps, office space, buildings for housing fire and crash-truck equipment, etc. Floor plans of discussed layouts are shown. *Aero Digest*, July 15, 1945, pages 57–59, 132, 6 illus.

Blueprint for a Class V Airport. Concluding article in a series analyzing the facilities, operation, maintenance, personnel requirements, revenues, expenses, and distinguishing characteristics of the various classes of airports. In this article the Class V type of airport is examined in detail, as exemplified by the Municipal Airport operation at Cheyenne, Wyo. The operations, facilities, methods, and financial aspect of this airport are considered, and data are given about the location and layout of the field, its history, and its management. *Airports*, July, 1945, pages 18–22, 9 illus.

Approach to Reality. Tom Ashley. A report of how one municipal airport is planning to balance operating costs with revenues. Among the methods suggested are increased and fixed landing fees and higher charges for concessions. Current airport costs and revenues are listed to show why such rescaling is in order. A schedule of landing fees at twelve selected airports throughout the United States indicates the variation in such charges and the need for fixed fees. *Southern Flight*, July, 1945, pages 44, 45.

The Continuous Runway. Capt E. C. Evans Fox. A continuous-runway type of airport is proposed, together with solutions to some of the problems created by this kind of runway. The suggested airport is located in the middle of a runway 10,000 ft. long and 600 ft. wide. In addition to the space for emergency landings provided for by the width of the runway, there are numerous emergency sidings. Multiple electric cables built into the pavement are connected to beacons and other automatic devices to guide pilots in fog or night landings. Aircraft land one after the other, guided by automatic block systems similar to those used for railways or subways, and take off by using the sides of the runway. The traffic flow is reversed as the direction of the wind necessitates. The cross-wind problem is solved by means of tree or structure windbreaks. *Aviation Review*, June, 1945, pages 12–14, 4 illus.

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

Airport Merchandising. Dudley M. Steele. Continuing a series of articles investigating individual revenue-producing schemes for airports, this one contains suggestions for four potential sources of income. They are a gift shop; the sale of frozen confections; baggage storage lockers; and a steam bath and massage department. *Southern Flight*, July, 1945, pages 54, 59.

Armament

Aircraft Armament. Louis Bruchiss. A special section of *Flying Age* comprises a review of the defensive and offensive armament used in aircraft. Data relative to the development, design, operating principles, applications, and problems of each type of armament are included. The record is divided into six parts, the first dealing with prewar ordnance, the second with machine guns and cannon, the third with turrets, the fourth with gun sights, the fifth with rockets, and the sixth with the particular aspects of armament in the Pacific war. *Flying Age*, August, 1945, pages 29–41, 69–74, 45 illus.

Avigation

Finding the Navigational Stars. Part VII. Ben C. Kenny. The seventh in a series of continued articles begins with a brief review of the procedure involved in the analytic determination of the lines of position by the use of charts and tables. It describes a method by which the "fix" is determined, by comparing the computed altitude with the observed altitude of a given celestial body and drawing the intersecting lines of position. For this purpose, it is desirable to use celestial bodies whose bearings differ from each other by about 90°, and it is therefore essential for the navigator to be familiar with the location of the navigating stars in all parts of the sky. The current installment proceeds to describe four additional stars found in two parts of the July sky, these being Vega, Rasalague, Nunki, and Kaus-Australis. These stars are shown in night photographs and diagrams that include the constellations Lyra and Sagittarius. *Aero Digest*, July 15, 1945, pages 60, 61, 131, 3 illus.

Navigating in Merry England. Capt. Ken Lester. An American pilot tells of the navigation and flight-control methods and aids used in the British Isles. Explaining that consistently foggy weather and lack of distinctive terrain features make pilotage ineffective, he describes how flying is carried on by means of the "Darkie System," visual beacons, signalling flares, airdrome markers, the Mark II field lighting system, direction-finding radio facilities, radio-marker beacons, combined localizer and glide path, the "Fido" system of dissipating fog in emergencies, and emergency fields for disabled aircraft. The nonexistence of radio-range stations is noted. *Air Facts*, August, 1945, pages 11–15.

Business and Finance

Aircraft Investors Seen Facing Lower Dividends. Raymond L. Hoadley. Predicting that there will be a general downward trend in dividend payments by aircraft companies, the writer explains why this should be considered a healthy, normal condition and one that will not greatly affect stock values. He analyzes the trend as a manifestation of the action being taken by the aircraft companies to fortify their financial positions during the reconversion period. A report on United Aircraft Corporation's financial status serves as an example of one company that reduced dividends while earnings are still high, in order to build up reserves. *Aviation*, July, 1945, pages 112, 250, 252, 254.

Civil Aviation

Airworthiness of Civil Aeroplanes. W. Tye. The position of airworthiness in the field of safety is discussed. Attention is drawn to those airworthiness matters to which the designer could most profitably direct his efforts. It is stated that there seems to be no doubt that the general standard of safety can be raised still further by improvement of the airworthiness of the airplane. If this is to be done without reduction in the efficiency of the airplane in other respects, the airworthiness provisions must be more closely related to the conditions under which the airplane

Boeing Stratocruiser

GIANT PLANES that will speed across tomorrow's skyways are dreams no longer. You will be seeing them more and more frequently . . . great ships like Boeing's new Stratocruiser now in service as the C-97. When peace comes, it becomes a high-speed, low-fare transport for more than 100 passengers. As a luxury sleeper plane, it will have 72 seats or 36 berths on the upper deck, and a lounge, dining salon, crew quarters and cargo space below. It has a top speed of 400 miles per hour and can fly 3500 miles.

Planes like the Stratocruiser, equipped with PESCO precision-built products, are typical of many military developments which will be ready to serve in other fields. PESCO experience in meeting the exacting demands of military aviation will be available not only to commercial aviation, but also to industry in more effective applications of Pressurized Power and Liquid Flow. For descriptive literature, write PESCO Products Company, (division Borg-Warner) 11610 Euclid Avenue, Cleveland 6, Ohio.

In Precision Hydraulics, Fuel Pumps, Air Pumps, Related Accessories . . .

PERFORMANCE POINTS TO Pesco FIRST

PATTERN FOR TOMORROW'S AIRLINES. Along with good planes and pilots, the new regional and local airlines starting in business will need the best and most complete instrument equipment they can buy. Instruments are the backbone of safe operation . . . the kind of operation our pioneer airlines have taught the nation to expect in scheduled air transportation. Instruments also have everything to do with regularity of service, and this regularity of service—around the clock, around the calendar—means not only service to the public but the fullest and most economical use of the new air carrier's investment in equipment. Tomorrow's airlines will find Kollsman accuracy and dependability important aids to the safety, regularity and economy of their operations.

KOLLSMAN AIRCRAFT INSTRUMENTS

PRODUCT OF

SQUARE D COMPANY

ELMHURST, NEW YORK • GLENDALE, CALIFORNIA

operates. Airworthiness standards can also be raised by improvements in detailed design, probably without serious weight or other penalties. *The Journal of The Royal Aeronautical Society*, June, 1945, pages 353–360.

Is There a Business Towing Airplanes? Capt. Ralph S. Barnaby. Air towing of disabled aircraft from outlying points to their home fields is suggested as a potential source of revenue for aircraft service operators. In addition to indicating the business advantages of such enterprise, the writer describes techniques of air towing which would make it possible. *Airports*, July, 1945, page 44, 1 illus.

Air Markers for Air Travelers. Details are given about porcelain-enameled, steel-segmented sections that are available for air markers. Said to be impervious to adverse weather conditions, these sections can be assembled readily into letters, figures, or symbols, as desired. They conform to C.A.A. suggested standards for air marking. *Aero Digest*, July 15, 1945, page 110, 1 illus.

Companies

Bristol Aircraft Corporate Portrait. The 35-year history of the Bristol Aeroplane Company, Ltd., is outlined, from the foundation of the company by Sir George White in 1910. The establishment of the first small factory at Filton and the growth of the business are reviewed. How the company's various models were evolved is related. *Air News*, July, 1945, pages 49, 50, 8 illus.

Design

The High Wing Monoplane for the Private Flyer. Richard G. Naugle. Beginning a two-part design study of the high-wing monoplane type of light aircraft, this article contains notes on the probable future of this type of plane. Merits and limitations of the type are outlined, and design improvements that are claimed to be needed if the high-wing monoplane is to retain its present popularity are indicated.

Materials for effecting the greatest design economies are cited, while certain broad aspects of the question of metal vs. tubing and fabric as it applies to fuselage design are discussed. This includes a comparison of the process required for an all-metal and a fabric-covered tubing fuselage. Features of a design representing the ultimate in this type of airplane, according to the views of the writer, are described. *Western Flying*, July, 1945, pages 40, 41, 76, 78, 3 illus.

Designing for Milling. Paul Dutter. The writer gives some basic rules that should be considered by the engineer when designing for the machine shop. This design procedure is directed toward the reduction of production time, and the elimination of drawing changes and the rejection of parts. *Industrial Aviation*, July, 1945, pages 47, 48, 50, 8 illus.

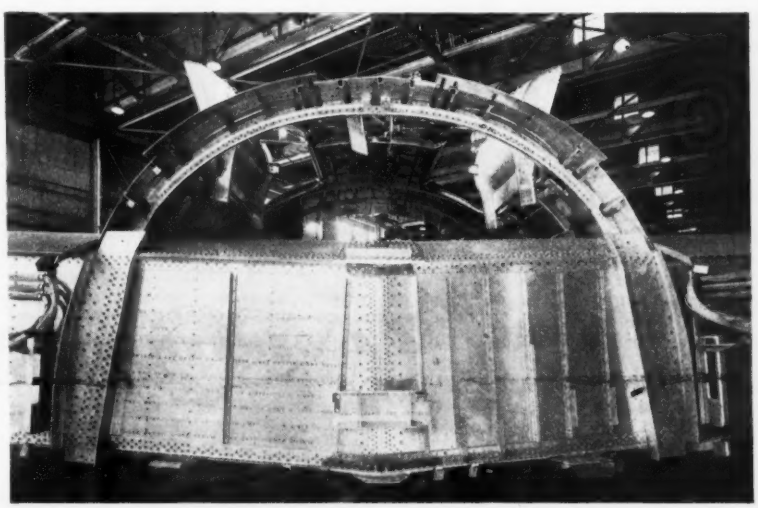
Flying Slow. Design and engineering details of two experimental British aircraft are reviewed. The airplanes are the General Aircraft G.A.L. 38 and the airspeed A.S. 39, built in 1937 to the Royal Navy specification for a shipboard airplane capable of an extremely slow cruising speed combined with long duration, which could maintain contact with enemy fleets during hours of darkness. Proposed before the development of radar, the chief requirements with which these aircraft complied were (1) a cruising speed of 38 knots for a duration of 6 hours; (2) an exceptional field of view for the crew at cruising attitude; (3) dimensional restriction for shipboard stowage; and (4) minimum noise at low cruising speed. *The Aeroplane*, June 15, 1945, pages 688, 689, 6 illus.

Generation of American Attack Bombers. Lt. Peter M. Bowers. Following two articles that traced the evolution of American fighter planes, this third article of a series is concerned with the chronologic development of U.S. attack bombers. In brief detail it traces the succession of American attack bombers from the G.A.X. of 1922 to the North American A-36 Invader. A group of 30 photographs illustrates various models mentioned. *Air News*, July, 1945, pages 20–24, 64, 31 illus.

Design Details of the Goodyear Model K Airship. Capt. C. V. S. Knox. The first part of a comprehensive study of the Goodyear Model K airship used by the U.S. Navy for patrol and convoy escort work. Particulars investigated in Part I include design and construction details about the airship's envelope components; pressure-control system; car suspension; air and valving systems; controls; bow-stiffening and mooring parts; empennage parts. The means of maintaining the Model K's pressure differential is explained, as is the method of erecting the airship for operation. Numerous photographs and schematic drawings supplement the design analysis. *Aero Digest*, July 1, 1945, pages 64–71, 150, 154, 156, 12 illus.

"See-Through" Parts Involve Laws of Optics. D. A. Rothrock. It is noted that a "see-through" part is that portion of a formed or fabricated piece for which vision through a transparent area is provided in the design. It is stated that, in the course of an investigation of the application of Plexiglas on airplanes, the Rohm & Haas Company discovered that poor optical design in the transparent enclosures of some planes was interfering with the efficiency and accuracy of the operations of the aircraft. The investigation revealed the need for recognition of certain basic laws of optics in the designing of see-through parts. The principles are set forth in this article. *Plastics and Resins*, July, 1945, pages 7–12, 27, 28, 21 illus.

Folding Wings. Maurice F. Allward. The development of folding-wing design for naval aircraft is traced. Various methods evolved for the folding of an airplane's wings are exemplified by indicated features of British and American naval planes. Among the wing-folding arrangements noted or described are those employed for the Sopwith Baby and Pup seaplanes; Hawker Osprey; Fairey Swordfish, Albacore, Barracuda, and Firefly; Supermarine Seafire; Grumman Marlet, Avenger, and Hellcat; and Vought Corsair. In a discussion of some of the specific engineering problems connected with wing folding, the more important design requirements for a folding-wing plane are listed. *The Aeroplane*, June 22, 1945, pages 718–721, 14 illus.



Wing-to-fuselage splice fittings of a Liberator B-24 as seen looking toward the rear spar.

EVERYWHERE YOU LOOK, YOU SEE

Sensenich Propellers

THAT is not an idle boast. Sensenich, in twenty years, has become the world's largest manufacturer of wood aircraft propellers. There is scarcely a pilot in America who hasn't flown behind a Sensenich propeller.

For years, Sensenich has been *standard equipment* on aircraft powered under 250 HP made by leading aircraft manufacturers.*

Sensenich is stocked and sold by all of the country's leading distributors who, in turn, supply hundreds of aircraft service operators and other retail suppliers.

When you visit airports or schools, military or civilian, look at the flight lines. You'll find Sensenich *right on the nose,* nine times out of ten.

When you leaf through the pages of your favorite aviation journals and directories, note the propellers on the ships shown in the editorial pages as well as in the advertisements. More often than not, if the propeller is made of wood, you can see a tiny trade mark shaped like this: That is the sign of Sensenich . . . the sign of a good propeller . . . a sign you can trust. Sensenich Brothers, Adjacent to Municipal Airport, Lancaster, Pa.; West Coast Branch, Glendale, Calif.

* *Piper, Aeronca, Taylorcraft, Fairchild, Culver, Stinson, Ryan, Ercoupe, Grumman, Bellanca, Howard, Luscombe, Meyers, Monocoupe, Porterfield, Rearwin, Funk, Boeing.*

Swing a AIRCRAFT SENSENICH PROPELLERS *and be sure*

PROP SHOP *Repair service now available on any type wood propellers. Prompt service. Address Sensenich Brothers* PROP SHOP, *Lancaster, Pa., or Glendale, Calif.*

Design Analysis of Consolidated B-24 Liberator. J. H. Famme. One of a design-analysis series, this article contains a comprehensive survey of the design, engineering, and construction principles of the B-24 Liberator. Among the components of the plane upon which attention is concentrated in the examination are the fuselage, wings, fuel tanks, and anti-icing system. Numerous sectional drawings, photographs, and tables of data supplement the text. *Aviation*, July, 1945, pages 121–143, 41 illus.

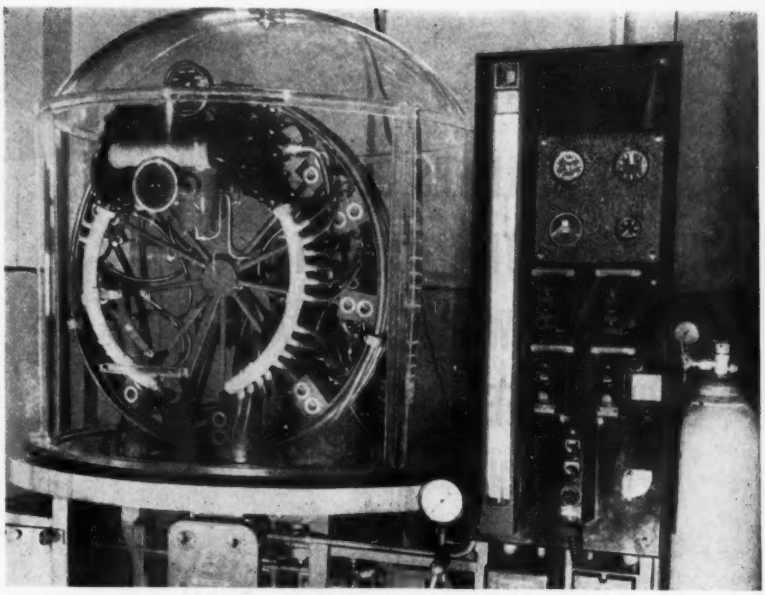
Selected Design Features of the P-51D Mustang. Illustrated by schematic drawings of various components, this article reviews the design and construction of the North American P-51D. It also presents the general descriptive data, specifications, and dimensions of this long-range fighter. Among the features noted are those relative to the fuselage, wings, ailerons, empennage, controls, landing gear, hydraulic system, air-induction system, cooling systems, and armament. *Aero Digest*, July 15, 1945, pages 64–68, 131, 7 illus.

Elongation in Aircraft Spars Caused by Riveting Operations. C. H. Smith. This article describes the procedure and results of an investigation carried out by the Consolidated Vultee Aircraft Corporation to find the amount of elongation in aircraft section spars caused by riveting, and to determine whether this elongation causes misalignment of the holes. The investigation included different ratios of rivet length-to-diameter, and different thicknesses of material. These tests indicated that, when the material thickness is small in comparison with the rivet diameter, the elongation is not related to the thickness of the material. *Product Engineering*, July, 1945, pages 471–473, 4 illus.

Details of the Coronado PB2Y-3 Design. Ernest G. Stout. Constructional details of the Coronado flying boat are set forth in this design analysis. The design of the wings, hull, ailerons, tail group, and other important components is described. Information is given about the power-plant group, interior heating system, controls, armament, and beaching gear. Service and repair features are discussed. An extensive table of specifications is included. *Automotive and Aviation Industries*, July 15, 1945, pages 18–22, 116, 118, 12 illus.

Design Analysis of the Curtiss-Wright "Helldiver." John A. Henderson. In this extensive analysis, design features of the Curtiss-Wright Helldiver are set forth and discussed. The construction of the wings, fuselage, empennage, landing gear, and other components is described in detail. Particulars are given about the power plant and engine cowling. Drawings of the complete plane and its component parts are included. *Industrial Aviation*, July, 1945, pages 7, 8, 10, 12, 13, 15, 16, 18–23, 21 illus.

Better Lightplanes for Tomorrow. T. Bowring Woodbury. The Vice-President and General Manager of Culver Aircraft Corporation states that, in their present stage of development, personal airplanes are not practical for the quantity market which must be reached in order to sell them in the volume necessary to attain low cost of manufacture. He claims that it is the responsibility of the manufacturers to make flying universally acceptable by designing planes that are "safe" through elimination of the chance for pilot error. Factors that contribute to this "safe" characteristic are noted. *Aero Digest*, July 15, 1945, page 48, 1 illus.



Wright Aeronautical Corporation's Plexiglas "bell-jar" test chamber for testing ignition harness under simulated high-altitude conditions.

Designing Tomorrow's Personal Plane. Part II. Ralph H. Upson. Second part of an article on the various design problems involved in developing a light plane for the postwar quantity market. In this installment five possible types of single-engined enclosed landplanes are analyzed and compared from the standpoints of performance and cost. The basis for estimating weight and drag is established and applied to each design type.

Design formulas are developed for weights, drag and efficiency, power and performance. With the conditions that all must meet outlined, the types considered are (1) cantilever, low-wing tractor with retractable tricycle landing gear; (2) cantilever, low-wing tractor with retractable conventional landing gear; (3) cantilever, low-wing tractor with fixed conventional landing gear; (4) braced, high-wing tractor with fixed conventional landing gear; (5) braced high-wing pusher with fixed tricycle landing gear.

As a result of the comparison, the writer's conclusion is that the best performance per dollar value among these particular designs is yielded by the low-wing tractor with fixed conventional landing gear. *Aviation*, July, 1945, pages 145–148.

Electrical Equipment

Governor Requirements for Aircraft Alternator Drives. W. K. Boice and L. G. Levoy, Jr. Reference is made to the engineering thought that has been directed recently toward the use of a.c. power systems in large aircraft. To permit operation at substantially constant frequency, when generators are driven by accessory-drive shafts of main aircraft engines, variable-ratio transmissions have been designed. The ratio of such a transmission may be varied by means of a governor that maintains generator speed within a narrow range while the aircraft-engine speed varies over a wide range. The writers set forth some of the results of a study that was undertaken to establish performance specifications for governors for variable-ratio transmissions. The study was conducted as a part of the development program for certain military aircraft. *Electrical Engineering*, July, 1945, pages 534–540 (Transactions), 17 illus.

Advanced Electrical Systems for Large Aircraft. M. M. Rockwell. This is Part I of a continued article on the electrical requirements for large aircraft. It is noted that because of the development of large transport planes requiring extensive electrical applications, aircraft electrical systems have outgrown the primitive battery-and-magneto stage and are becoming miniature replicas of commercial power systems. In order to provide a background for the analysis of electrical system problems, a summary is made of the electrical applications in a large aircraft. The writer then discusses "system engineering" problems, a.c. and d.c. systems, and stability limits. *Industrial Aviation*, July, 1945, pages 64–66, 68, 5 illus.

A Current-Limiting Fuse for Aircraft Applications. A. H. Powell.

TWA STRATOLINERS GET INCREASED HEATING COMFORT, LIGHTER WEIGHT, LOWER UPKEEP COSTS WITH THE JANITROL WHIRLING FLAME!

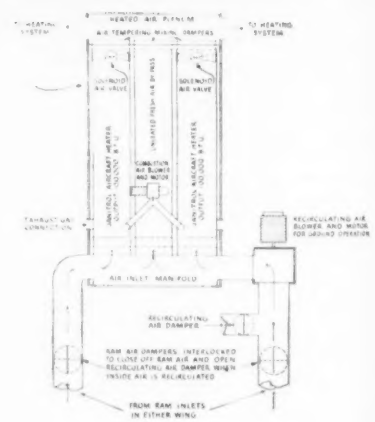
Two men easily slide the heating package, complete with two Janitrol combustion heaters and all controls, into the belly of the Stratoliner.

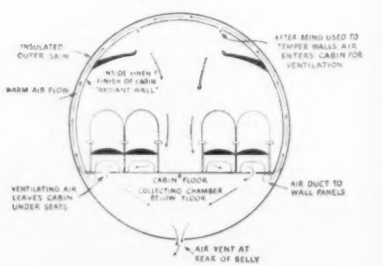
WHEN TWA designed a new and different heating system for their fleet of Stratoliners, they chose as its heart *Janitrol Whirling Flame Aircraft Heaters!* Actual flight experience has *proved* that a new *high* has been reached in passenger comfort, a new *low* in maintenance costs.

POSITIVE CONTROL OF TEMPERATURE. Exact and continuous control of the circulating air in flight and on the ground is possible because Janitrol operates independently of the plane's engines. No uncomfortable hot or cold blasts, uneven temperatures, falling off of heat while landing.

LOW-COST UPKEEP. After more than 1000 hours of flight TWA reported, "No failure nor special maintenance work on the heaters." When maintenance *is* required, the light-weight Janitrol heating package is easily removed and replaced in a matter of minutes.

Information on Janitrol Whirling Flame Aircraft Heaters for every *type of application* is yours for the asking . . . why not write us about your present and postwar heating problems.


HEATED AIR PLENUM
TO HEATING SYSTEM
AIR TEMPERING MIXING DAMPERS
SOLENOID AIR VALVE
SOLENOID AIR VALVE
JANITROL AIRCRAFT HEATER OUTPUT 100,000 B.T.U.
JANITROL AIRCRAFT HEATER OUTPUT 100,000 B.T.U.
COMBUSTION AIR BLOWER AND MOTOR
EXHAUST GAS CONNECTION
RECIRCULATING AIR BLOWER AND MOTOR FOR GROUND OPERATION
AIR INLET MANIFOLD
RECIRCULATING AIR DAMPER
RAM AIR DAMPERS INTERLOCKED TO CLOSE OFF RAM AIR AND OPEN RECIRCULATING AIR DAMPER WHEN OUTSIDE AIR IS RECIRCULATED
FROM RAM INLETS IN EITHER WING


INSULATED OUTER SKIN
WARM AIR FLOW
INSIDE WHEN FINISH OF CABIN "RADIANT WALL"
AFTER BEING USED TO TEMPER WALLS, AIR ENTERS CABIN FOR VENTILATION
CABIN FLOOR
COLLECTING CHAMBER BELOW FLOOR
AIR DUCT TO WALL PANELS
VENTILATING AIR LEAVES CABIN UNDER SEATS
AIR VENT AT REAR OF BELLY

COMPLETE JANITROL HEATING PACKAGE FOR DC-3 PLANES WILL SOON BE AVAILABLE

Complete compact heating system measuring only 26½" x 13" x 60" includes two 100,000 Btu Janitrol Aircraft Heaters with all necessary controls (except cabin thermostat) and blower for ground operation.

By utilizing existing DC-3 duct work, installations can be made quickly and economically.

This newest Janitrol system was designed especially for DC-3's, to improve passenger comfort and to reduce heating maintenance costs. All component parts have been proven in military and transport service.

Janitrol

AIRCRAFT HEATER DIVISION • SURFACE COMBUSTION CORPORATION • TOLEDO 1, OHIO

The characteristics of existing fuse devices for aircraft electrical systems are reviewed. The survey indicates many applications for an improved interrupting device. A description is given of a new current-limiting fuse that has been designed to meet the requirements. Test data are supplied to indicate the suitability of this improved current-limiting fuse. *Electrical Engineering*, July, 1945, pages 541–544 (Transactions), 11 illus.

Engines

Prediction of Engine Tooling Requirements. William M. S. Richards and Frank H. Erdman. This article deals with aircraft engine-cooling correlation methods. It is noted that the expression "cooling correlation" refers to the analyses and predication of engine-cooling requirements for any given set of air and engine variables. Reference is made to the difficulty encountered while attempting to correlate altitude cooling requirements with sea-level performance, which led to the resumption of extensive study of the cooling correlation problem by the Wright Aeronautical Corporation early in 1942. It is explained that any correlation of this nature endeavors to establish the relation between engine-operating conditions, cylinder-head temperature, pressure drop across the engine, pressure and temperature of the cooling air, cooling-air consumption, and heat rejection to the cooling air. A description is given of a correlation method that is based on the density of the air as it leaves the fin passages, which involves the temperature rise and pressure drop of the cooling air.

Information is given about a graphic solution of the equations which require a knowledge of only the entering air conditions to obtain solutions for all the cooling requirements mentioned. The method was applied to a specific Wright engine model to obtain the necessary constants. *SAE Journal*, July, 1945, pages 410–419 (Transactions), 13 illus.

Power-Plant Efficiencies. A. V. Cleaver. The propulsive efficiencies of propeller-engine combinations, jet units, and rockets are discussed from a mathematical point of view. The first part of the article deals with the thermal efficiency of aircraft engines and the second with the propulsive efficiency of fluid reaction-propulsion systems. A chart shows expressions for propeller, jet propulsion, and rocket propulsive efficiency. Various expressions for rocket propulsion efficiency are shown in a second chart. *Aircraft Engineering*, June, 1945, pages 156–158, 2 illus.

D.H. Gipsy Major I. Brief notes pertinent to the history and service of the de Havilland Gipsy Major I engine explain why and how the interim between complete overhauls for this engine was extended to 1,500 hours running time. A typical case history is given of an engine inspection routine for ascertaining whether the Gipsy Major I should be allowed to run on in service for a period of 1,500 hours without major overhaul. Two tables supplement the article. These list the various Gipsy engine models, the year each was introduced, a brief description of each model, its horsepower, and the number of hours permitted between top and complete overhauls. *Flight*, June 7, 1945, page 611, 1 illus.; "De Havilland Gipsy Development," *The Aeroplane*, June 8, 1945, page 661, 1 illus.

A Russian Aero-Engine. Lionel Mote. Some design details and specifications are given about the Russian liquid-cooled AM. 34 aircraft engine. The information is largely based on references contained in the book *Aero-Engines—Design and Detail Calculations*, edited by A. E. Zaikin of the Joukowsky Military Aviation Academy, of Kiev, and published in 1941 by the State Publishing House of the Defence Industry. In addition to descriptions of the principal engine components, details are given about the reduction gear, valve and accessory drive mechanisms, the supercharger, and its driving gear. A photograph shows the 950-hp. version of this engine, which was exhibited at the 1936 Paris Aero Salon. Full-throttle brake-horsepower and power-required-by-propeller curves are shown. Drawings illustrate the design of the component parts. *Aircraft Engineering*, June, 1945, pages 159–165, 28 illus.

Flight Technique

Reconversion of a Pilot. Wm. E. Cobb. This article takes into consideration some of the problems encountered by a military pilot in flying a light plane. Differences in the required techniques for military and civilian flying are noted, with the transition from the more complex to the simpler type of plane demonstrated to be not quite so easy as it might be thought. *Air Facts*, August, 1945, pages 34–37.

Wings Afloat. Charles J. Hawkins. Differences in the handling characteristics of seaplanes and landplanes are indicated. The specialized techniques required for operation of a seaplane during the taxiing, take-off, and landing stages are described briefly. *Air News*, July, 1945, pages 25–28, 56, 58, 6 illus.

Kick That Ball. Wolfgang Langewiesche. An explanation of the function of the bank indicator and how it operates. Advice is given about what flying p actice should be followed for keeping the plane in level flight and the "ball at center." *Flying*, August, 1945, pages 43, 126, 130, 4 illus.

How to Fly a P-38. The specialized techniques for operating the Lockheed P-38 Lightning are outlined. Advice is given regarding flight procedures during taxi and take-off; climbing and cruising; stalls, dives, and spins; single-engine practice; and landing. *Air News*, August, 1945, pages 24–26, 64, 5 illus.

Fuels

Fuel Development. The contributions of fuel development to increased power output of aircraft engines are outlined. Important milestones in the evolution of high-grade fuels for aircraft engines are traced from the fuel used for aircraft participating in the Schneider Trophy seaplane tests in 1927 to the standard 100/130-grade fuel now used for military purposes by the Allied air forces. *Flight*, June 7, 1945, pages 612, 613, 2 illus.

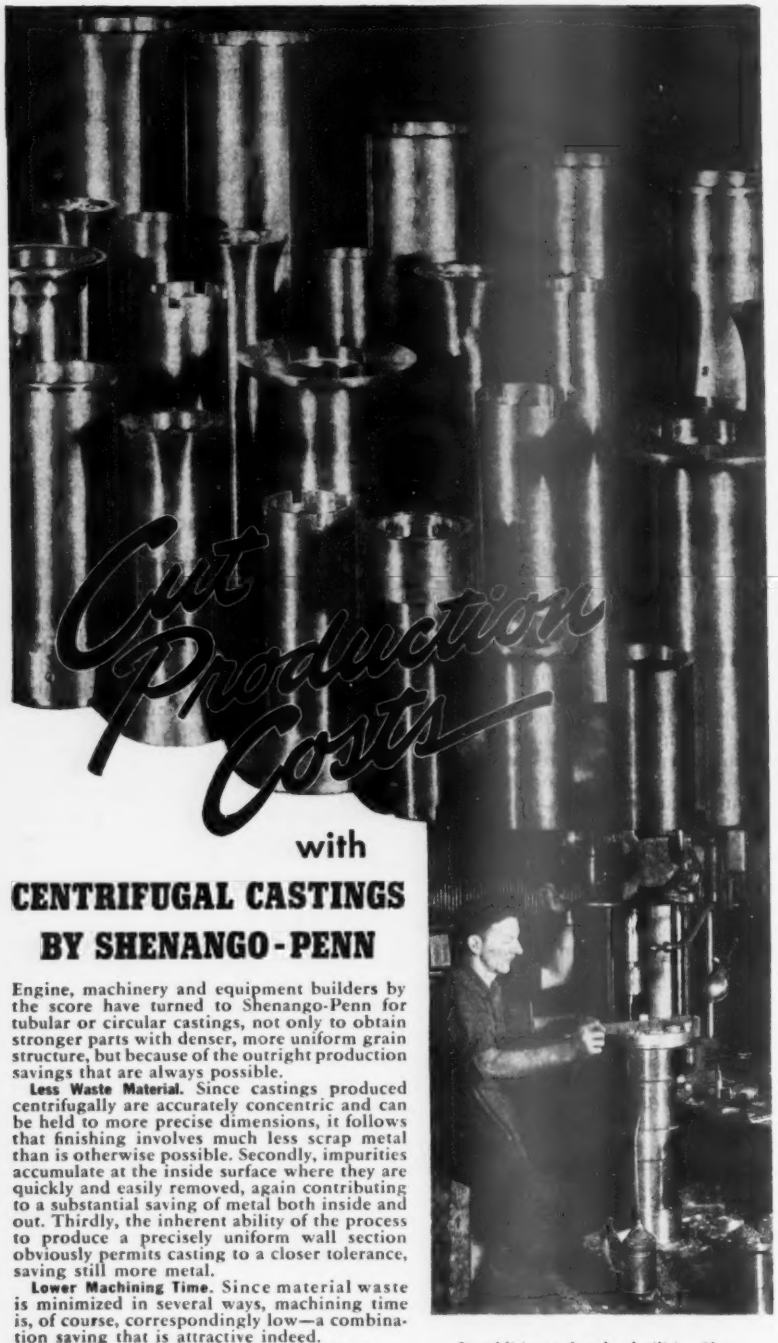
Gliding and Soaring

Conversion of C-47 to Glider Opens New Vista. Sydney Carter. How the C-47 has been successfully converted into a high-performance glider, designated as XCG-17, is described. It is stated that the XCG-17 can be towed at speeds up to 290 m.p.h. as compared with the present 200-m.p.h. limit for conventional gliders. It has a long, flat glide angle of 14-to-one as compared with a 10- or 12-to-one ratio for the conventional CG-4 Army glider, and a stalling speed of 35 m.p.h. as compared with 55 m.p.h. for the CG-4. Further, it is reported to be the only A.A.F. cargo glider requiring no ballast when flown at minimum weight conditions. Information is also given about a method that has been developed in which two C-47's in tandem are used to provide assisted take-off and climb in the launching of gliders. After altitude is reached, one C-47 is cut loose. *American Aviation*, August 1, 1945, page 74, 3 illus.

The D.F.S. Reiher. B. S. Shenstone. The first part of a continued article contains descriptive data and technical details about the Reiher, a prewar German glider design. General, aerodynamic, and structural particulars are related in this installment. Tables of relevant information are included in the article. *Soaring*, July-August, 1945, pages 5–7, 12, 13, 9 illus.

Hydraulics

The Live Line Hydraulic System. T. W. Boden Hardy. The purpose, design, construction, operating principles, and advantages of the Dowty Live Line pump are surveyed. Providing pressures of up to 3,000 lbs. per sq.in., this pump reportedly enables an aircraft's complete hydraulic system to be simplified considerably. It eliminates the necessity for an automatic cutout valve, a pressure-relief valve, and an accumulator, by performing a fourfold function: pumping; pressure relief; flow regulation; and pressure stability. Included in the illustrations that help to



with

CENTRIFUGAL CASTINGS BY SHENANGO-PENN

Engine, machinery and equipment builders by the score have turned to Shenango-Penn for tubular or circular castings, not only to obtain stronger parts with denser, more uniform grain structure, but because of the outright production savings that are always possible.

Less Waste Material. Since castings produced centrifugally are accurately concentric and can be held to more precise dimensions, it follows that finishing involves much less scrap metal than is otherwise possible. Secondly, impurities accumulate at the inside surface where they are quickly and easily removed, again contributing to a substantial saving of metal both inside and out. Thirdly, the inherent ability of the process to produce a precisely uniform wall section obviously permits casting to a closer tolerance, saving still more metal.

Lower Machining Time. Since material waste is minimized in several ways, machining time is, of course, correspondingly low—a combination saving that is attractive indeed.

Bulletin 143 gives complete information about Shenango-Penn centrifugal castings including other advantages and specifications of the various available alloys. Write to the Shenango-Penn Mold Company, 2353 W. Third Street, Dover, Ohio.

In addition to foundry facilities, Shenango-Penn is well equipped for all kinds of machining and finishing operations. Here flanges of bronze castings are shown being drilled.

ARMY NAVY SHENANGO - PENN

ALL BRONZES • MONEL METAL • ALLOY IRONS

explain how this is accomplished is a functional diagram of the pump's mechanism. *The Aeroplane*, June 8, 1945, page 664, 3 illus.

Electronic Analysis of Airplane Hydraulic Systems. Duncan B. Gardiner. Performance requirements for airplane hydraulic braking systems are summarized and discussed. Information is given about the use of a multielement oscillograph, by means of which the various characteristics of the braking system can be recorded simultaneously so that the value of design changes can be easily determined. Oscillograms for a typical aircraft braking system show that relatively minor changes result in a wide differential in performance, and emphasize the conclusion that design changes in a hydraulic brake system should be evaluated with the oscillograph. *SAE Journal*, July, 1945, pages 420–426 (Transactions), 14 illus.

Inspection

Machinability of Cast Magnesium Ingots. L. R. Jackson and W. W. Beaver. Particulars are given about a machinability test that has been developed for investigating the cleanliness of magnesium ingots used in making aircraft castings. This test is based on the destruction of the machining ability of a drill that is standardized by grinding the point to 45°. Charts show the results of drill-wear tests on various ingots and on reprocessed metal. *Industrial Aviation*, July, 1945, pages 54, 55, 97, 4 illus.

Sectional Radiography. Robert Taylor. The writer describes how the problem of determining the depth of defects during the radiography of materials, such as aircraft castings, may be solved by the use of "sectional radiography." Particulars are given about the method, the equipment required, and the practical results obtained. *Metals and Alloys*, July, 1945, pages 99–101, 3 illus.

Fracture Characteristics of Magnesium Castings. P. F. George. This article deals with the interpretation of fractures in magnesium castings to determine the various causes of failures. Consideration is given to detecting the type of fracture resulting from poor design or improper use. The writer describes how the type of stress responsible for the failure can be determined by an examination of the path of the fracture through the structure of the metal. *Aluminum and Magnesium*, June, 1945, pages 14–17, 8 illus.

Checking Pulley Conditions. Ed Packer. Brief information is given about the inspection of aircraft pulleys. Various defects that may be found in the pulleys are illustrated and discussed. *Aviation Service Magazine*, May-June, 1945, pages 28, 29, 6 illus.

Instruments

Precision Testing of Electric Tachometers. M. A. Princi. Particulars are given about a system for testing magnetic-drag electric tachometers de-

veloped for the measurement of aircraft-engine speed and designed to meet the requirements of high accuracy. It is intended to be suitable for use in the large-quantity manufacture of tachometers. The system provides facilities for testing at 22 scale points in a range of speeds from 500 to 4,500 indicated r.p.m. without referring to a standard instrument. The power to drive the tachometers being tested is supplied from tachometer generators that are driven by a d.c. motor controlled by a precision tuning fork. The method of operation and the control system are explained. *Electrical Engineering*, July, 1945, pages 504–508 (Transactions), 15 illus.

Postwar Outlook for Aircraft Instruments. Part II. Esther Forbes. The second part of a continued article surveying the possible applications of wartime developments to postwar aircraft instrumentation investigates the potentialities of various instruments manufactured by the Eclipse-Pioneer Division of Bendix Aviation Corporation. Among the instruments surveyed are this company's brake mean effective pressure gage, Magnesyn remote-indicating system, air-position indicator, gyro horizon, attitude gyro, automatic pilot, gyro Flux Gate compass, bubble sextant, fuel flowmeter, and power indicator. *Southern Flight*, July, 1945, pages 38, 39, 60, 8 illus.

Flight Engineer Develops New Engine Computer. A description of a new calculator that enables flight crewmen to obtain engine-performance figures without the aid of graphs and complicated mathematical computations. Developed by a Consolidated Vultee engineer for use in connection with Pratt & Whitney R-1830 engines, this device is said to be alterable for application to other types of power plants. It consists basically of five plastic discs joined at a common center and having an overall diameter of approximately 8 in. How various engine-performance data are obtained by manipulation of these discs is explained in the article. *Western Flying*, July, 1945, pages 60, 82, 1 illus.

Checking Diffuser in Rate of Climb Instruments in the Shops of Northwest Airlines. M. G. Boe. The equipment used by Northwest Airlines for checking diffusers in rate-of-climb instruments is described and illustrated. Checking and calibrating methods are explained. *Aviation Service Magazine*, May-June, 1945, pages 20–22, 4 illus.

Lubrication

Engine Oil Foaming. H. A. Ambrose and C. E. Trautman. Particulars are given about a study of the foaming of engine oil which led to the development of what is called antifoam agents. It is stated that, when added to the oil, these inhibitors eliminate foaming under most conditions and have no detrimental effect on the oil. Data are supplied on the effects of oxidation and temperature on foaming, the effect of antifoam agents on oxidation, and the effect of antifoam agents on oil properties during engine tests. *SAE Journal*, July, 1945, pages 373–376 (Transactions), 5 illus.

Oil System Problems at High Altitude. W. L. Wheeler. Reference is made to several new oil-system problems that have become evident as a result of the war stimulus to increase the operation and altitude of military aircraft. Oil-system problems resulting from high-power and high-altitude operation are listed. The various parts of an oil system are described in detail to show their effect on the overall performance of the system as related to these problems. Curves are included to show oil-pump performance and oil-tank efficiency. Examples are given to illustrate the characteristics of various oil-system configurations as a means of explaining why the problems listed are encountered. Explanations of the various difficulties are offered and practical methods to achieve a remedy are suggested. Consideration is given to the effect of oil foaming and fuel in the oil. An analysis is made of oil-system performance using antifoaming additives. A brief outline is given of future work that should be conducted to achieve improvement in oil-system performance. *SAE Journal*, July, 1945, pages 402–409 (Transactions), 9 illus.

Maintenance

EAL Forestalls Sticking Valves. A procedure is described which is stated to predetermine in most cases the time when exhaust valves will start to stick unless the guides are reamed. A special rocker-arm wrench, used in conjunction with a tension wrench, is attached to the rocker arm to determine the maximum number of in.lbs. required to move a valve from the open to the closed position. The in.-lb. tension is checked and recorded on a valve record form maintained for each engine. Whenever the tension recorded at the initial valve-clearance check period is exceeded by 50 in.lbs., the guide is reamed. *Air Transport*, July, 1945, page 50, 2 illus.

Tie-Down Storage. Gilbert C. Close. Advice is given about the special precautions to be taken for protecting an airplane that is stored out of doors. Procedures are suggested for safeguarding the various parts of the plane against damage wrought by dust and moisture. *Western Flying*, July, 1945, pages 38, 39, 66, 68, 6 illus.

Hydraulic Systems. The elementary principles of aircraft hydraulic systems are set forth. This information is intended for those who are comparatively new in the work of maintaining aviation equipment. *Aviation Service Magazine*, May-June, 1945, pages 14–16, 42, 4 illus.

Precision Plus. Arthur Smith. A description is given of the devices and specialized methods developed at the Miami shop of Pan American Airways for the overhaul of precision instruments. Illustrations show some of the equipment used for overhauling, adjusting, and calibrating the instruments. *Air Transport*, July, 1945, pages 42–44, 46, 49, 17 illus.

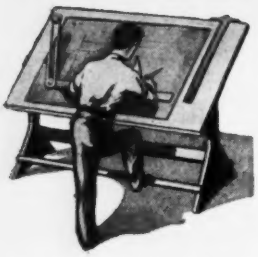
Wartime Repair of an Ercoupe Wing. M. F. Foose. It is noted that the normal way to repair a damaged wing of an Ercoupe would be to buy a new tip for the spar and splice it in, but under prevailing conditions such tips were not available. The writer describes how to effect the repair by using the sheet-metal machinery available in a well-equipped repair shop. *Aviation Service Magazine*, May-June, 1945, pages 24–26, 48, 9 illus.

How to "Size" the Overhaul Shop. Part VI. E. F. Lindsley. Continuing a series of articles examining the various phases of aircraft-engine service and overhaul, the sixth installment compares two types of overhaul organizations. One is set up for the so-called intermittent process, in which the work is adapted to "custom" overhaul of each engine as a separate project; the other is set up for continuous-flow overhaul, in which a large number of overhauls on similar engines are conducted on a quantity-production basis. Characteristics of each type of organization and the factors that govern their operation are discussed. Two typical examples of the small, flexibly operated type of shop are described, while the large overhaul depot is exemplified by an actual shop employing about 1,200 workers. Two organization charts illustrate the distribution of personnel in each type of shop. *Aviation*, July, 1945, pages 180, 181, 249, 250, 2 illus.

Management

Estimating Direct Labor Cost in Aircraft Production. Jack Chassan. A method of estimating month-by-month labor requirements is described. It is based on the concept of the unit man-hour reduction or learning curve and the time-cycle pattern. As a prelude to the description of this method, the writer reviews some ideas about learning curves and presents a few pertinent observations with respect to time-cycle length and the distribution of unit man-hours within the time cycle. *Industrial Aviation*, July, 1945, pages 56, 58–62, 96, 97, 10 illus.

Accounting System for Airplane Dealers. Franklin M. Reck. The Reynolds & Reynolds accounting system for aircraft service operators is described. An aircraft adaptation of automotive accounting systems, this system deals with the following sources of income: sales of new and used aircraft; flight income from instruction, passenger carrying and renting planes; ground-school income; service income; sales of parts at wholesale and retail prices; sales of accessories; income from airplane storage; and line income, including sale of gasoline, oil, antifreeze, etc. Provision is also made for such miscellaneous departments as a restaurant and recreational facilities. *Aero Digest*, July 15, 1945, pages 88–90, 5 illus.



In light-metal assemblies, the "rub comes" in the tapped threads. Rapid abrasion causes loose threaded fastenings or stripped threads.

"Heli-Coil" Stainless Steel Inserts prevent wear of tapped threads by providing a hard metal lining between the hard screw or stud members and the soft tapped threads. Made of helical coils of precision-shaped wire, they engage fully with tapped threads of the American National System.

"Heli-Coil" Inserts are installed much faster—weigh one-fifth as much—occupy less than half as much cross-sectional area as solid bushings of the same inside diameter. Write today for informative Bulletin No. 239.

ENGINEERING REPRESENTATIVES:

DETROIT — G. C. Brown and A. W. Reader, 201 South Pleasant St., Royal Oak, Michigan

KANSAS CITY — Pacific Airmotive, 1628 McGee St., Kansas City 8, Mo.

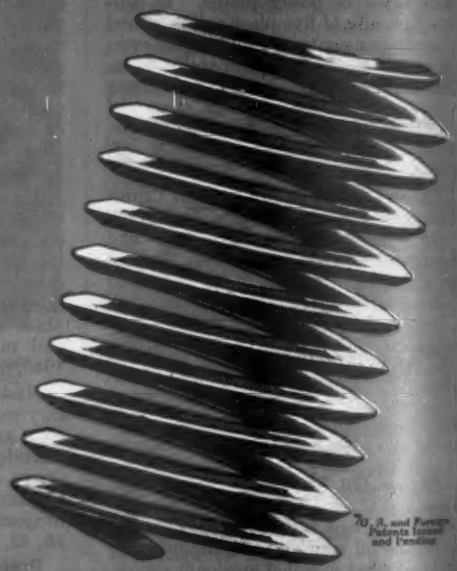
LOS ANGELES — J. S. Wise, Room 925, Pacific Mutual Bldg., 523 West 6th St., Los Angeles, Calif.

THE SCREW SYSTEM WITH THE ANTI-FRICTION THREAD LINING

HELI COIL

Heli-Coil

INSERTS PROTECT TAPPED THREADS IN LIGHT METALS & PLASTICS



U. S. and Foreign Patents Issued and Pending

AIRCRAFT SCREW PRODUCTS COMPANY, INC.

47-23 35th STREET • LONG ISLAND CITY, L. N. Y.

Marketing

Utility Is the Range-Finder in Civil Plane Market Forecasts. Neil B. Berboth. A method is detailed for estimating the potential consumer market for personal aircraft. This method takes into consideration the utility possibilities of the private airplane, defining and evaluating them as a factor in the market projections. The writer analyzes the degree of utility which may be feasibly attained by the personal airplane in the near future, as well as the requirements that must be met in order to attain this utility. Tables of data have been compiled, giving the following information and estimates: money spent for personal transportation (1952 as typical of the 1947–1957 decade); annual amounts that could be spent to own and operate a personal plane; estimated potential personal airplane market, 1947–1957; estimated personal airplane market, 1947–1957, at varying percentages of total potential market penetration; and estimated characteristics of postwar personal planes. *Aviation*, July, 1945, pages 113–117.

Materials

Magnesium Design Considerations and Applications. John C. Mathes. The physical, chemical, and metallurgic properties of magnesium alloys are discussed. Particular attention is given to the application of magnesium to aircraft structures. A description is given of work that was carried out by the Dow Chemical Company in cooperation with the Navy Department Bureau of Aeronautics to demonstrate, by the design and construction of full-sized wing panels, that magnesium is structurally efficient for such applications. Information is given about the design of the magnesium wing, tests, and the service record. Results of the tests are tabulated. *Mechanical Engineering*, July, 1945, pages 468–472.

Applications and Advantages of Constructional Alloy Steels. The selection and application of alloy steels is discussed with particular reference to their use in such parts as gears, shafts, drills, springs, connecting rods, etc. Part of the article is devoted to alloy steel used in the aircraft industry, and alloy steels that find wide application in this field are listed. *Steel Processing*, July, 1945, pages 442–445, 5 illus.

Properties of a General Purpose Aluminum Sand Casting Alloy. R. A. Quadt. The requirements for aluminum sand-casting alloys are examined. Alloy characteristics in which foundrymen and designers generally are interested are listed. It is noted that no single aluminum alloy fulfills all the requirements. Attention is given to the optimum copper and silicon content, the effect of pouring temperature on F430 alloy, the effect of room-temperature aging on this alloy, and the effect of various heat-treatments. *Aluminum and Magnesium*, June, 1945, pages 18, 19, 22, 23, 9 illus.

Influence of Overaging on Aluminum Alloys. Information is given about tests conducted by Northrop Aircraft, Inc., on high-strength aluminum-alloy sheet to determine the effects of overaging on physical and corrosion-inhibiting properties. Tables show the effect of aging aluminum alloys for 24 hours at various temperatures and the mechanical properties of high-strength aluminum-alloy sheet subjected to overaging at 375°F. *The Iron Age*, July 19, 1945, pages 66, 67, 140, 142; "Properties and Workability of 75S Aluminum Alloy," by M. Raskin, *Product Engineering*, July, 1945, pages 481–483, 6 illus.

Medicine

The Autokinetic Illusion and Its Significance in Night Flying. Comdr. Ashton Graybiel and Lt. Brant Clark. In this extensive report the writers describe experiments designed to study the causes of accidents apparently attributable to confusion or disorientation of the pilot, particularly in night flying. The difficulties seemed to involve disturbances in equilibrium, states of confusion in which there was inability to think properly, temporary loss of the "track of events" because of "dopeyness" or of undue fascination on objects, and various types of optical illusions. The experiments were conducted at the Naval Air Training Base, Pensacola, Fla. It is noted that autokinesis refers to certain illusory perceptions of movement of an object in the visual field when other visual references are inadequate. Experiments were carried out both in the laboratory and during formation flights at night. The experiments are described in detail and the results are summarized in text and tables. *The Journal of Aviation Medicine*, June, 1945, pages 111–151, 2 illus.

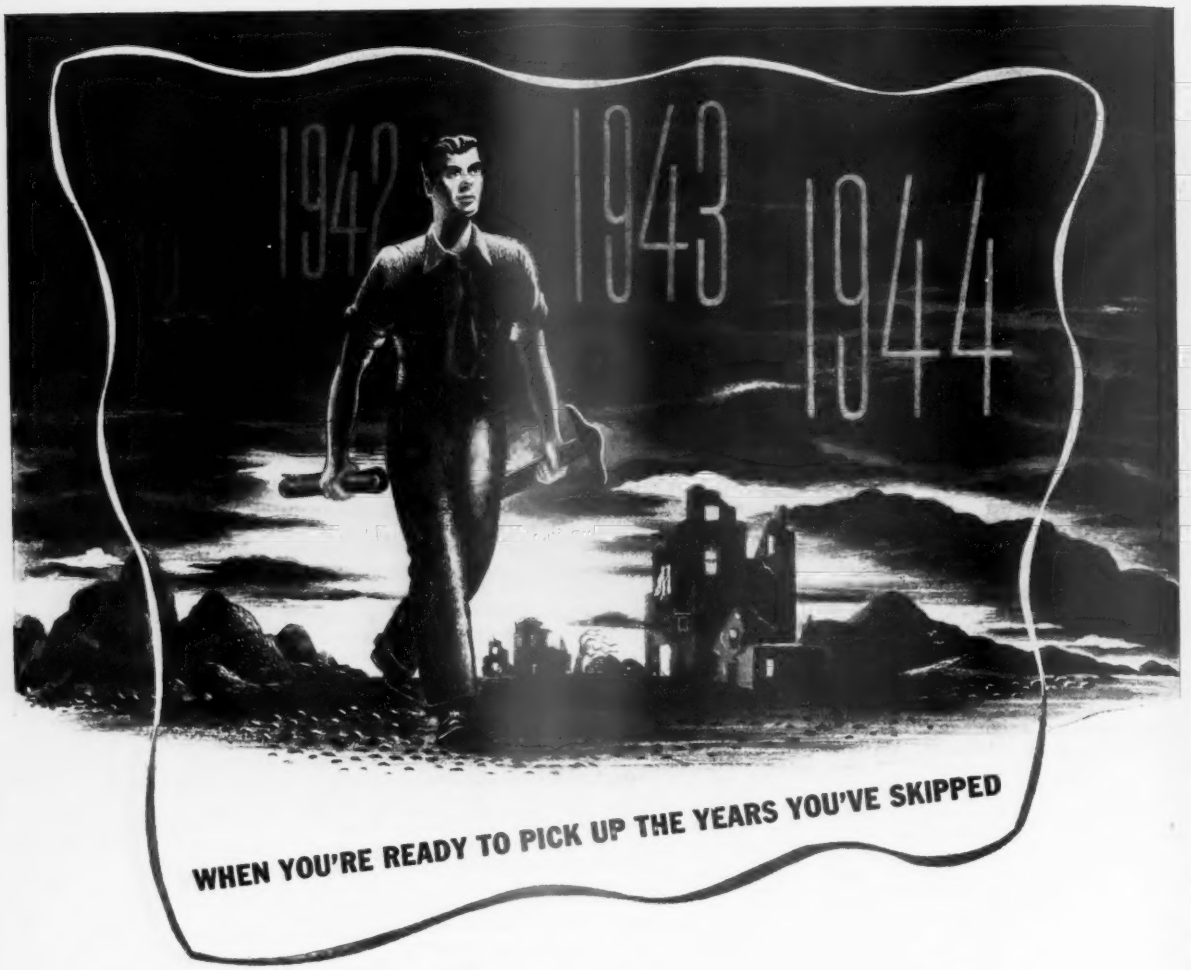
Development of Active Pulmonary Tuberculosis as the Probable Result of Decompression Sickness at Simulated Altitudes Above 40,000 Feet. Alvan L. Barach, Artell E. Johnson, and Colter Rule. This paper reports two instances in which activation of old minimal pulmonary tuberculosis followed frequent exposure to altitudes of 40,000 ft. or higher in a decompression chamber. A study of these cases indicated that the exposure did not produce the original disease. It is considered probable that the previous lesions were quiescent but were reactivated by local trauma to the lung parenchyma produced when air or other gases expanded in or near a tubercle. It is stated that the dangers described are unlikely where personnel are exposed to altitudes less than 18,000 ft., as in commercial flying. *The Journal of Aviation Medicine*, June, 1945, pages 152–155.

Duration of Consciousness in Anoxia at High Altitudes. Capt. C. G. Mackenzie, Capt. A. H. Riesen, Lt. J. R. Bailey, Lt. T. N. Tahmisian, and Sgt. P. L. Crocker. Tests were conducted to determine the time required for the development of symptoms of anoxia at various altitudes. Curves relating the duration of useful consciousness to altitude, following interruption of the oxygen supply, are presented for two groups of individuals, together with the variations encountered at each altitude and with a detailed account of the methods employed. The conclusions reached are summarized. *The Journal of Aviation Medicine*, June, 1945, pages 156–164, 174, 4 illus.

Quarantine Procedures with Special Reference to Air Travel. Capt. Thomas B. Magath. The writer expresses conclusions regarding air-traffic quarantine which are based on those reached by an Interdepartmental Quarantine Commission established to study the entire problem of world quarantine with special reference to military traffic. It is indicated that some definite changes in quarantine procedures concerned with the airplane are required. It is stated that the airplane and its passengers should be processed before the take-off and a simple quarantine declaration used which should establish clearance upon landing at any port of entry. In general, the use of artificial immunization against quarantinable disease when the passenger is liable to be exposed to such disease should form the basis for international travel and the plane should be disinsectized after loading and immediately after departure. When indicated, and passengers fail to be immunized, a system of surveillance or detention should be practiced. *The Journal of Aviation Medicine*, June, 1945, pages 165–174.

Nutritional Control of Foods Served in the Royal Canadian Air Force. Air Commodore J. W. Tice, Group Capt. F. F. Tisdall, and Squadron Leader J. F. McCreary. It is stated that at the outbreak of the present war it was found that the Royal Canadian Air Force was receiving a ration that did not take into consideration many of the recent discoveries in nutrition and was not adequate. The work carried out by a committee appointed to revise the scale of rations is described. Further efforts to improve the health of the R.C.A.F. personnel included educational campaigns using motion pictures in which the human body was likened to an airplane, booklets, nutritional laboratories, and test kitchens. Tables give lists and assays of foods served, and a chart shows the blood ascorbic acid levels of selected R.C.A.F. recruits before and after experimental diets. *The Journal of Aviation Medicine*, June, 1945, pages 181–186, 1 illus.

Survival Off the Land. Capt. Richard A. Howard. It is explained that the chief medical problem involved in emergency survival for a man parachuting from an aircraft into unfamiliar territory is how the individual can retain his physical advantages. Problems



WESTON CAN TELL YOU LOTS

That's NEW about Sensitive Relays!

Many engineers concentrating on specialized wartime problems have had little opportunity to keep posted on all new developments in the electrical field. Many of these developments, too, could not previously be revealed for security reasons.

But now, with civilian activities in closer sight, these engineers will want to find out how far electrical science has moved forward in the years they have skipped.

In sensitive relays, for example, much has happened which will be of vital importance to design engineers. New sensitivities have been achieved by WESTON . . . making available relays that provide positive control on extremely minute quantities of electrical energy. New compactness has been achieved, too; overcoming former space limitations through extremely small-size and light-weight.

To make sure that your post-war products, or manufacturing processes, are not handicapped by lack of knowledge about these new sensitive relay developments, ask the WESTON representative in your vicinity to quickly bring you up-to-date. Or, write direct to . . . Weston Electrical Instrument Corporation, 687 Frelinghuysen Avenue, Newark 5, New Jersey.

Weston *Instruments*

ALBANY • ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DALLAS • DENVER • DETROIT • JACKSONVILLE • KNOXVILLE • LOS ANGELES • MERIDEN
MINNEAPOLIS • NEWARK • NEW ORLEANS • NEW YORK • PHILADELPHIA • PHOENIX • PITTSBURGH • ROCHESTER • SAN FRANCISCO • SEATTLE • ST. LOUIS • SYRACUSE
In Canada, Northern Electric Co., Ltd., Powerlite Devices, Ltd.

of sanitation, rest, water, food, etc., which the airman must solve in order to survive, are discussed. *The Journal of Aviation Medicine*, June, 1945, pages 187–191.

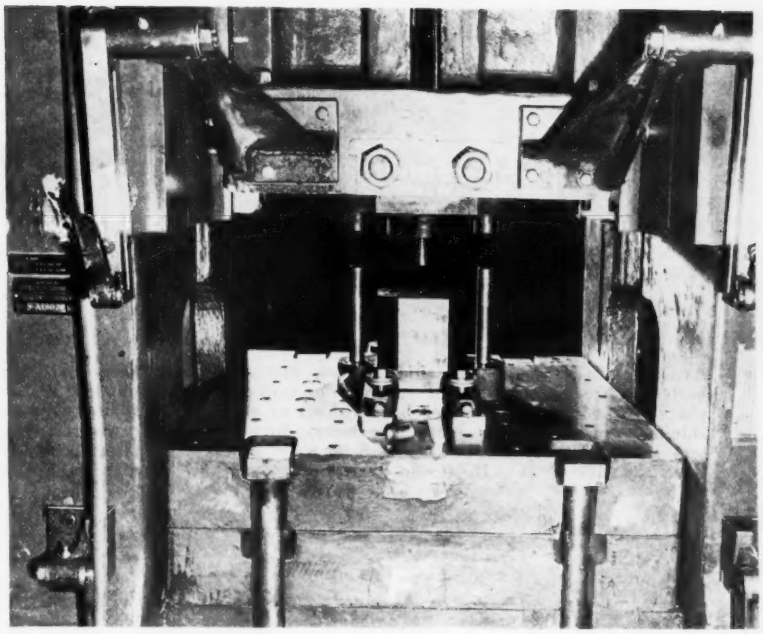
The Immediate Treatment of Burns at Naval Air Stations. Lt. Comdr. John G. Stubenbord 3rd. The treatment of burns during the first 24 hours at naval air stations is discussed, and precautions for fire prevention in aircraft are outlined. Features of the therapy advocated are stated to be its adequateness and its practical simplicity. Besides the trilogy of modern therapy—morphine, sulfonamides, and plasma—local therapeutic measures (consisting of nondebridement, no cleansing, bland ointment with protective dressing) and oxygen therapy are used. *The Journal of Aviation Medicine*, June, 1945, pages 192–202.

Personal Equipment Officers and the Care of the Flyer in the AAF. Major Samuel R. M. Reynolds. An outline is given of the duties of the personal equipment officer, who is responsible for keeping the flier flying. The techniques and facilities employed by personal equipment officers, which, it is noted, differ from those used by the medical officers, are described. The essential ingredients of a well-run equipment section are enumerated. The organization of the personal equipment section is discussed and illustrated by means of a chart. *The Journal of Aviation Medicine*, June, 1945, pages 202–204, 208, 2 illus.

Metallurgy

Heat Treatment of Stainless Steel for Exhaust Manifolds. Wilson G. Hubbell. Tests are described which were undertaken at the metallurgical laboratory of the Ryan Aeronautical Company to determine the benefits, if any, of stabilizing and stress-relief heat-treatments for types 321 and 347 of the 18-8 stainless steels used in exhaust manifolds. These grades of stainless steel are stabilized by the addition of columbium and titanium and by a special heat-treatment that precipitates carbon to form columbium or titanium carbides in random dispersion within the austenitic grains, so that no carbon is available for the formation of harmful chromium carbides if the alloy is to be used within the so-called sensitizing range of about 900° to 1,500°F. It is agreed that the stabilizing heat-treatment may be required from the standpoint of resistance to corrosion in electrolytes and highly corrosive solutions, but the results demonstrate that adequate stabilization of the carbides is present for exhaust-manifold use without the special heat-treatment. Photomicrographs are reproduced in connection with the explanation of how these conclusions are reached, it being shown that less corrosion of an exhaust-manifold section took place in 4,000 hours of actual service use than in 48 hours of corrosion tests with strong electrolytes.

The writer states that analyses made of the described exhaust-manifold materials have been unable to show that excessive carbide precipitation or intergranular corrosion, or a combination of these, has any effect upon service failure which could be attributed to electrolytic corrosion. The tests for determining the effect of carbide distribution are outlined and discussed. The opinion is expressed that certain strength benefits are obtained by the stabilizing heat-treatment, and that such data may be a more important factor in the service life of a manifold than any actual corrosion of the material caused by the exhaust gases. *Aero Digest*, July 1, 1945, pages 98, 100, 103, 104, 163, 8 illus.



A type of extrusion die used for producing small cylindric parts in the process of cold-impact extrusion of aluminum parts by Douglas Aircraft Company, Inc.

Corrosion Resistance of Clad 24S Aluminum Alloys. C. M. Marshall. Reports are given of the results of corrosion-resistance tests in which clad 24S aluminum alloys were exposed to a salt-spray solution for 500 hours and to accelerated corrosion media containing salt and hydrogen peroxide for a 48-hour period. The results of further tests which showed more accurately the rate and extent of corrosion on protected and unprotected aluminum alloys when exposed to accelerated corrosive media also are given in tabular form. *Automotive and Aviation Industries*, July 1, 1945, pages 28, 29, 3 illus.

Meteorology

Constant Pressure Maps—Methods of Preparation and Advantages in Their Use. J. R. Fulks. The advantages derived from the use of constant pressure charts as a method of upper-air analysis are set forth. Information is given about the construction of these charts, with the necessary formulas and tables. *Bulletin of the American Meteorological Society*, May, 1945, pages 133–146, 6 illus.

Computing 10,000-Foot Pressures from Surface Data. Lt. Francis K. Davis, Jr., and Lt. William H. Klein. Formulas are developed for computing 10,000-ft. air pressures from surface data. It is stated that each formula gives good results in the area for which it was derived and in areas with similar meteorologic conditions. It is noted that the formulas give better results than either the assumption of a moist adiabatic or a constant average lapse rate.

The first constant in each formula is a function of the average lapse rate. The remaining terms account for 25 to 35 per cent of the possible variation from the average. Therefore, the formulas give errors in extreme cases of stability or instability. It is stated that the formulas give better results at middle latitudes and at coastal stations, where daily variability of lapse rate is comparatively small, than at high latitudes and at inland stations, respectively, where daily variability of lapse rates is greater. *Bulletin of the American Meteorological Society*, May, 1945, pages 147–152.

A Flight into the September, 1944, Hurricane off Cape Henry, Virginia. Col. F. B. Wood. An account is given of a flight into the interior of the September, 1944, hurricane. The flight was carried out for the purpose of obtaining information about the effect of turbulence on the flight of aircraft within a tropical hurricane. Major Harry Wexler, Research Executive of the Weather Division of the Army Air Forces, and Lt. Frank Record, of the Forecast Branch, participated in the flight. The writer piloted the aircraft, which took off from Bolling Field, Washington, and emerged from the hurricane at a point 30 miles east northeast of Norfolk.

Available in both 12 volt and 24 volt types. All batteries are equipped with special non-spill vent plugs and assembled in either hard rubber or radio-shielded aluminum containers. The heavy duty battery has a capacity of 105 A.H. at 5 hr. rate; others have capacity of 34 A.H. at the 5 hr. rate.

These spark plugs feature: (1) Direct contact non-inductive resistor located in coolest position in plug; (2) Improved copper cooled center electrode; (3) Deep drawn nickel alloy center electrode tip; (4) High Dielectric strength and superior mechanical properties of "Corundum," Auto-Lite's insulator material.

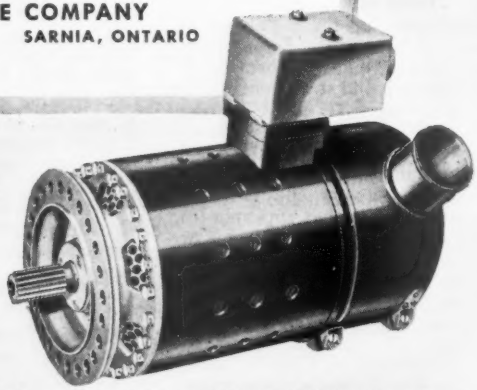
Auto-Lite

EQUIPMENT FOR AIRCRAFT

On every battlefront of this war where American-built planes are flying you'll find the products of Auto-Lite's 22 great manufacturing plants. Precision-built to meet the most exacting tests, these products, some of which are shown below, are enhancing the Auto-Lite reputation for quality, craftsmanship and dependability.

THE ELECTRIC AUTO-LITE COMPANY
TOLEDO, 1, OHIO • SARNIA, ONTARIO

This dual oil pressure gauge is one of several space and weight saving gauges precision-built by Auto-Lite. It records oil pressure from two engines on same dial, has easy readability and high degree of accuracy. Auto-Lite builds gauges and thermometers to Army-Navy Air Service specifications.



High output, light weight Auto-Lite aircraft generators have compensating windings resulting in long brush life—improved commutation and a remarkable ability to carry over loads. These generators are direct engine driven and designed to deliver 140 amperes at 28.5 volts at 2275 to 4500 r.p.m.

AUTO-LITE

TUNE IN "EVERYTHING FOR THE BOYS" STARRING DICK HAYMES—EVERY TUESDAY NIGHT—NBC NETWORK

In a supplementary article by Major Wexler the probable structure of the storm is reconstructed by analyzing and putting together the observations made by the three observers. *Bulletin of the American Meteorological Society*, May, 1945, pages 153–159, 4 illus.

Use of "Pressure-Pattern Flying" Over the North Atlantic. Capt. Howard E. Hall. "Pressure-pattern flying" over the North Atlantic is discussed from the historical angle. The writer reviews early flights from which pilots learned many of the peculiarities of North Atlantic weather, including the structure of fronts, modifications occurring during the history of storms in that area, the characteristics of ice accretion, and the changes to be expected in wind direction and velocity associated with pressure areas. *Bulletin of the American Meteorological Society*, May, 1945, pages 160–163.

Military Aviation

R.A.A.F. Serial Identification Numbers. The classification of airplanes of the Royal Australian Air Force is briefly discussed. A table gives the serial identification numbers of these aircraft. *The Aeroplane Spotter*, June 14, 1945, page 136.

Polar Flights by the R.A.F. A correspondent gives an account of polar air-exploration missions undertaken by the Royal Air Force in May, 1945. The flights were made by an Avro Lancaster, starting from Shawbury, England, flying over the North Geographical Pole, landing at various points in Canada, and returning to England. They covered 17,720 miles, during which scientific investigations were made with regard to the position of the Magnetic Pole and the performance of navigating instruments. About 2,000 photographs were made during the flights. *Aeronautics*, July, 1945, pages 54, 55.

Naval Aviation

U. S. Navy Issue. The major part of the July issue of *Aviation Maintenance* is devoted to a group of articles about the aviation activities of the U.S. Navy, with particular regard to maintenance procedures. The Navy section begins with congratulatory messages to the naval personnel by Rear Admirals DeWitt C. Ramsey, Harold B. Sallada, and L. B. Richardson, U.S. Navy, and contains the following articles: The Bureau of Aeronautics; Lighter-Than-Air; U. S. Marine Corps Aircraft Maintenance; Naval Air Transport Service; Naval Air Technical Training Command; Mobile Air Trainers; Training Carrier Aircraft Service Squadrons; Specialized Training for Combat Servicing; Carrier Operation and Maintenance; Pacific Lifeline (Aviation Supply); Pearl Harbor Strikes Back; Servicing Planes for Combat; Combatting Corrosion at the Equator; New Planes for Old; Forward Area Aircraft Pool; Saipan Seabase; Floating Repair Shops for Patrol Bombers; New Combat Service Records for "Liberators"; U. S. Marines Aircraft Repair Base; U. S. Navy's Beneficial Suggestions Program; Aircraft Service Changes; Aircraft Spares; Periodic Inspections for Aircraft. *Aviation Maintenance*, July, 1945, pages 44–244.

The Naval Aviation Safety Program. Lt. Comdr. Marion T. Martin and Lt. Comdr. Kenneth S. Scott. The history of the Naval Aviation Safety Program is briefly reviewed. The organization and functions of the Command Safety Board and Unit Aviation Safety Board are discussed. *The Journal of Aviation Medicine*, June, 1945, pages 175–180, 201, 3 illus.

Paints and Coatings

Tests on Iridite Finish. Kenneth E. Dorcas and N. H. Simpson. A report on tests that were made to investigate the protection that the Iridite treatment offers cadmium- and zinc-plated steel. They were conducted by the Fort Worth Division of the Consolidated Vultee Aircraft Corporation. Independently made tests indicate that the Iridite treatment applied to either cadmium or zinc plate results in greater corrosion resistance than untreated plate, this chemical finish being more essential for zinc than for cadmium plate. *The Iron Age*, July 26, 1945, pages 61, 143.

Personalities

Bell of Bell. Malcolm MacGregor. A biographic sketch of Lawrence Dale Bell, President and General Manager of the Bell Aircraft Corporation. Brief information is given about his background and past activities with The Glenn L. Martin Company and the company then known as Consolidated Aircraft Corporation. How he organized the Bell Aircraft Corporation is described. *Air Transportation*, July, 1945, pages 14–16, 4 illus.

Winston Churchill and Our Air Power. C. G. Grey. The part played by Winston Churchill in sponsoring and promoting the growth of British air power is traced from 1911 to the present date. It is claimed that more than any other man of cabinet rank, Churchill in his various governmental positions has laid the foundations of the Commonwealth's air strength. *The Aeroplane*, June 8, 1945, pages 655, 656, 2 illus.

The American Story. Carl Considine. In some brief notes the aeronautical careers of two aircraft executives are traced. One man is C. R. Smith, Chairman of the Board of American Airlines; the other Ralph S. Damon, President of the same company. *Airlanes*, July, 1945, pages 16, 57, 3 illus.

Personnel

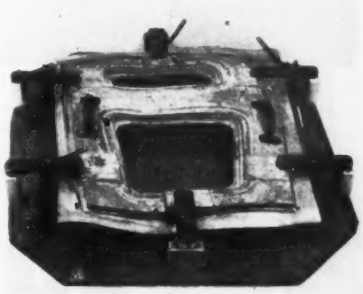
The Next Business Generation. A report is given, based on the work of the Personnel Distribution Command of the Army Air Forces, with regard to the postwar careers of members of the Air Forces returning from combat overseas. Comments are made about the results of a study conducted by the Command in collaboration with the *Fortune Survey* among 8,500 men passing through the redistribution stations of the A.A.F. in the Spring of 1945. Statistics are charted with regard to ages, grades, length of service, previous civilian occupations, postwar employment preferences, and other factors. *Fortune*, August, 1945, pages 50, 51, 184, 187, 188, 191, 8 illus.

The Sky Clerk Makes the Team. Lt. Tom Jefferson. With data given about the requirements and training for the job, the duties and work of a Flight Traffic Clerk are reviewed. As described, the Flight Traffic Clerk is a noncommissioned aircrew member of the Military Air Transport lines, who relieves pilots and copilots of all clerical functions. He is responsible for correct loading and unloading of all cargo, baggage and mail; maintenance of cabin discipline when passengers are abroad; courier duties; etc. *Air Facts*, August, 1945, pages 48–52.

Plastics and Plywood

Sandwich Structures with Foamed Core. J. D. Lincoln, Jr. A description is given of the equipment and processes used in the production of foamed-core structures, with particular reference to the production of the plastic nosepiece for a fast fighter airplane. After outlining the requirements, the writer details the steps involved in the manufacture of the inner and outer skins and the method of foaming the plastic for the core. The final steps are the preparation of the reinforced area for the attachment of the nose to the airplane fuselage, the curing of the material, and the final finishing by sanding the rough edges. It is stated that the principles developed for the manufacture of this aircraft part can be applied to other structural items. *Modern Plastics*, July, 1945, pages 132–135, 14 illus.

Fighter Fuselage in Plastic. As an example of how synthetic materials can be substituted in aircraft construction,

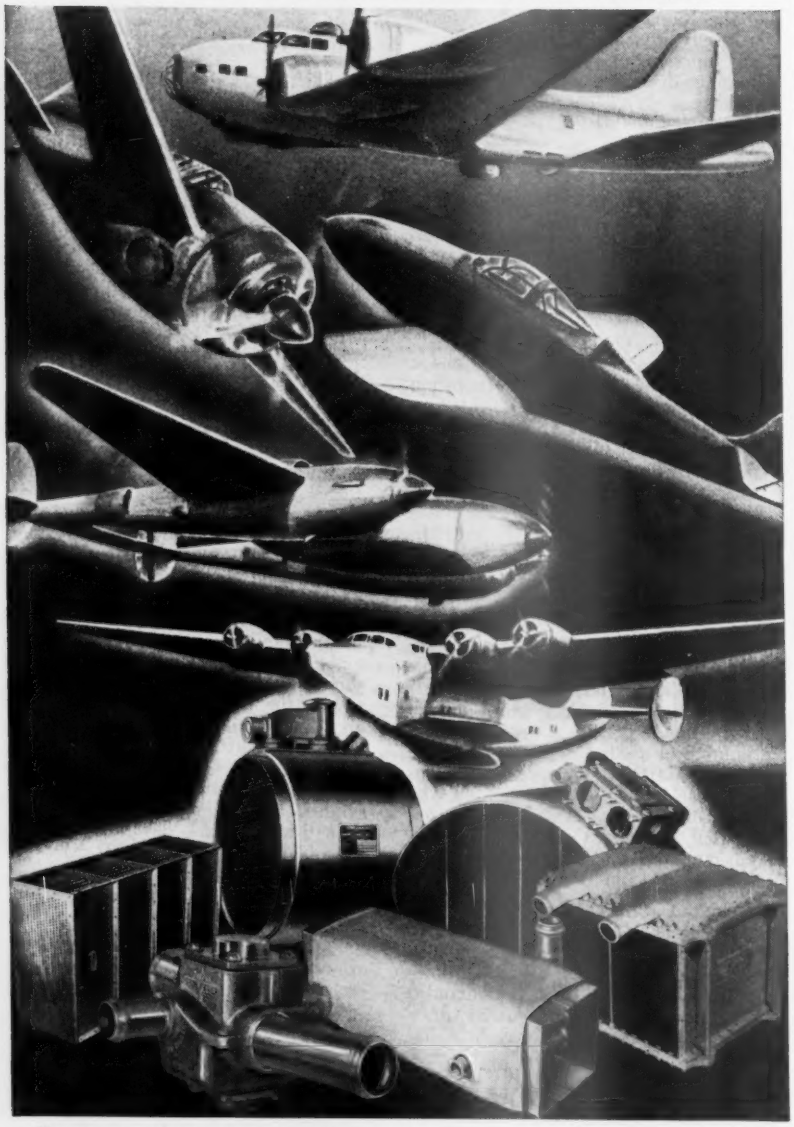


Photograph Courtesy Lockheed Aircraft Corporation

Formed router block with Celastic hold-down plate, used in the fabrication of plastic tools. The formed sheet-metal part is nested and held in position as shown, and excess flange is trimmed.

HEAT TRANSFER SPECIALISTS

TO THE AVIATION INDUSTRY



Changes come fast in the aviation industry. New ideas replace old, and make new problems in heat transfer. For more than a quarter century, Young engineers have worked with aircraft engineers, solving new problems as they came . . . developing oil coolers, coolant radiators, supercharger intercoolers, cabin heaters and temperature regulating systems. That's why Young stands ready now with the experience and manufacturing facilities to design and produce special or standard heat transfer units for every need.

YOUNG

HEAT TRANSFER PRODUCTS

Oil Coolers • Gas, Gasoline, Diesel Engine Radiators • Intercoolers • Heat Exchangers • Engine Jacket Water Coolers • Unit Heaters • Convectors • Condensers • Evaporators • Air Conditioning Units • Heating Coils • Cooling Coils • and a Complete Line of Aircraft Heat Transfer Equipment

YOUNG RADIATOR CO., Dept. 475-J, Racine, Wis., U. S. A.

Distributors: Pacific Airmotive, Burbank, Cal.; Aircraft, Steel and Supply Co., Wichita, Kansas

an account is given of an experiment conducted in Britain in 1940. In this experiment, a plastic fuselage was built for a Spitfire aircraft. All structural parts of the fuselage were of Gordon Aerolite; cellulose-acetate sheet and cotton-reinforced phenol-formaldehyde sheet were used in a few subsidiary portions where they offered advantages; and riveting was employed with few exceptions for the entire assembly. Accompanied by illustrations, the information in the article includes data pertinent to the construction of the experimental fuselage as well as to the results of tests made with it. *Aircraft Production*, July, 1945, pages 323–326, 10 illus.

Plywood Repair Procedures. Specific procedures are outlined for patching impaired plywood surfaces. Methods of reinforcing flush patches in stressed skins are also described. Drawings illustrate the progressive steps of repair. *Aero Digest*, July 15, 1945, pages 84, 85, 12 illus.

Core Materials for Sandwich Structures. Capt. B. G. Rheinfrank, Jr., and Capt. W. A. Norman. Research work on synthetic core materials for sandwich-type structures for use in the construction of such parts as airplane fuselages is summarized and analyzed. The work was carried out by engineers of the Air Technical Service Command, Wright Field. *Modern Plastics*, July, 1945, pages 127–131, 13 illus.; "Glass-Plastic with Honeycomb Core," Capt. George B. Rheinfrank, Jr., and Capt. Wayne A. Norman, *Automotive and Aviation Industries*, July 1, 1945, pages 32, 33, 58, 60, 5 illus.

Plastic Tooling Procedures. Parts I and II. E. L. Maris. A two-part article on the use of plastics in the construction of tools discusses some of the results of research work carried out by the Lockheed Aircraft Corporation.

In Part I, the writer outlines the advantages that may be derived from the use of plastics in the fabrication of such tools as formed router blocks, forming dies, form blocks, scribe jigs, and jigs for drills, punches, and saws. He also describes some of the unique techniques developed for handling plastics and for incorporating different types of plastics in the same tool. Information is given about the characteristics of plastic materials and fabricating methods which have proved to be timesavers.

Part II contains a description of a detailed series of operations for incorporating thermoplastic casting materials with thermosetting casting resins and laminates in the construction of plastic tools used to form, trim, and drill a detailed air-frame part. *The Iron Age*, July 19, 1945, pages 55–61, 12 illus.; July 26, 1945, pages 74–81, 21 illus.

Sensitized Plywood Speeds Bomber Construction. This brief article describes how the Boeing Aircraft Company is using photographically sensitized plywood in its design and tooling program. *Industrial Aviation*, July, 1945, page 52, 2 illus.

Postwar Aviation

Aviation's Place in Civilization. T. P. Wright. In the introduction to the 33rd Wilbur Wright Memorial Lecture, Mr. Wright discusses the need for a universal reappraisal of the fundamental import of aviation and emphasizes his desire to see the airplane so utilized as to make it a positive force in the progress of civilization. He then proceeds to appraise the possibilities of aviation, to analyze the airplane's potential for good, and to draw such conclusions as appear to be warranted. He first examines the general problem and the scientific method of approach to the subject and then discusses the historical aspects of transportation, military aviation and war, government and civil aviation, technical development, and fields of usefulness for aircraft. The International Civil Aviation Conference at Chicago, and collective security are also discussed. *The Journal of The Royal Aeronautical Society*, June, 1945, pages 299–342, 25 illus. "Aviation's Place in Civilization," *Flight*, June 7, 1945, pages 614, 615, 2 illus.; June 14, 1945, pages 640–642, 8 illus. "Thirty-Third Wilbur Wright Memorial Lecture," *The Aeroplane*, June 8, 1945, pages 665, 666, 1 illus.; June 15, 1945, pages 683–685, 4 illus.

Low-Price Plane Potentials. R. T. Quick. Based upon graphs showing trends in light-airplane design, performance, and production since 1928, predictions are made as to the characteristics of airplanes under 150 hp. which will be sold within the next 10 years, their cost, and the volume of their sales. Prognostications are that the average top speed of such an airplane will be 150 m.p.h.; the average cruising speed, 135 m.p.h.; average landing speed, 50 m.p.h.; average cruising range, 450 to 500 miles; average useful load, 600 lbs.; and average selling price, under $1,500. It is further stated that the ever widening difference between maximum and landing speeds will increase the need for auxiliary devices such as flaps, slots, and controllable-pitch propellers. A yearly production volume of 8,000 to 20,000 planes, over a 10-year period, is indicated as the likely figure for planes under 150 hp. *Aero Digest*, July 15, 1945, pages 71–73, 7 illus.

They've Done Their Work. A. R. Eddie. Reasons are offered in justification of an intelligent program for destroying obsolete aircraft. It is explained why reconversion of certain military airplanes for use as air liners, freighters, private planes, or salvage parts is not feasible. *Commercial Aviation*, June, 1945, pages 40, 42.

Private Flying

A Small Plane Is Transportation. George V. Caesar. Citing the usefulness of the small airplane, the writer names some accessories and instruments that he considers necessary additions for the safe and efficient flying of a relatively slow airplane. These include two-way radio, DF equipment, a vertical-dial compass, and an attitude indicator. The writer also protests against "far-away" airports and large hangar fees as detriments to the popularization of private flying. *Air Facts*, August, 1945, pages 38–41.

The Right Planes for the Right Market. A plea is made for the light-plane manufacturing industry to make both three-control and two-control airplanes. It is claimed that a quantity market depends on meeting the demand for both types. *Airports*, July, 1945, pages 46, 47, 3 illus.

Return of the Private Plane. John C. Ross. A compendium is given of the plans of about 40 aircraft and engine companies for producing personal airplanes and engines for such types of planes. Summarizing data are given briefly for each individual company. The article also explains what a Government order permitting civilian planes to be built for the first time since war began means in terms of actual present production. *Flying*, August, 1945, pages 32–34, 78, 80, 84, 22 illus.

Selling by Air—A Case History. Reginald Snover. The advantages of utilizing personal flying for sales and contact purposes are indicated by an account of one salesman's experiences. He reports on the costs, speeds, time schedules, facilities, conveniences, and benefits of contacting customers located in different states by piloting himself in a rented plane. Overall costs and efficiency of these air trips are compared with what they would have been had the trips been made by automobile. The conclusion is that, compared to other forms of transportation, business air travel by means of light planes offers economy and efficiency plus such intangibles as advertising value, ability to be of assistance in an emergency, and greater personal comfort. *Aero Digest*, July 15, 1945, pages 78, 79, 1 illus.

Flying Clubs After the War. Major A. J. Deane-Drummond. A plan is proposed for postwar air education in Britain which, it is claimed, will make for large-scale pilot training at low cost to both the trainees and the government. Basically, the scheme is to combine the prewar type of light-plane club with the gliding or soaring club. It is proposed that all elementary training be done in dual-controlled sailplanes up to the first solo stage, that thereafter single-seater trainer sailplanes be used up to the final training stage, and that two-seater light-plane types be used in addition to high-performance sailplanes for the final stages of training. The costs of running such clubs and the equipment needed for them are considered. *The Aeroplane*, June 29, 1945, page 744, 1 illus.

Production

Fairey Barracuda. Part I. Wilfred E. Goff. Beginning a comprehensive study of the production methods involved in the manufacture of the Fairey Barracuda, this article contains details about the procedures and equipment employed for building the center section and main planes of the Fleet Air Arm torpedo bomber. Production details are preceded by a general description of the airplane, an outline of the requirements governing its design, and an analysis of its construction. Information regarding the fabrication and assembly of the discussed components is given under the following headings: center-section spar-frame assembly, center-section assembly, main plane, spar production, leading edge, aileron shrouding, and main assembly fixture. The article is supplemented by numerous illustrations, one of which is a cross-section drawing of the entire aircraft showing most of the characteristic features of the Barracuda. *Aircraft Production*, July, 1945, pages 309–320, 31 illus.

Sprayed-Metal Jig Members Speed Up Jet Plane Production. Charles O. Herb. How the Lockheed Aircraft Corporation is using metal spraying to save time in the construction of nest blocks for major jigs and fixtures used in the manufacture of the P-80 is described.

In this application of metal spraying, the metal is deposited on plaster forms to obtain nest blocks for various wing, fuselage, and other members of the jet planes. *Machinery*, July, 1945, pages 148–153, 10 illus.

Buzz-Bomb Pinions. Chester S. Ricker. A description is given of how components of the robot bomb have been simplified to permit rapid assembly on simple fixtures. Methods used at the plant of Willys-Overland Motors, Inc., for the construction of the American version of the V-1 are illustrated. *Wings*, July, 1945, pages 1621–1624, 16 illus.

Fusion Cutting by High-Speed Bandsaw. R. W. Hancock. How the Bristol Aeroplane Company, Ltd., adapted to its requirements a process for trimming the products of short-run forming tools is recounted. The process is based on the application of a high-speed bandsaw to the cutting of metal by frictional heat. Sections of the article discuss saw development, cutting tests, jig methods, machine specifications and costs, and maintenance. *Sheet Metal Industries*, July, 1945, pages 1205–1210, 6 illus.

Multiple Tapping of Magnesium and Aluminum. Charles O. Herb. Particulars are given about the results of a study carried out with the object of reducing tapping costs on aluminum and magnesium parts for aircraft engines, expediting production, and reducing scrap work. The study was made at the Melrose Park plant of the Buick Motor Division of the General Motors Corporation. The writer tells how the cause of tearing of threads in tapping

The inside of a sprayed-metal shell with expanded metal mesh in place, used in the construction of nest blocks for jigs and fixtures for the Lockheed P-80. The shell is contained within the plaster impressions of the master tooling model.

magnesium and aluminum was discovered and describes procedures developed to overcome the difficulty. *Machinery*, July, 1945, pages 178–183, 202, 10 illus.

The Gating of a Large Magnesium Casting. Anthony Cristello. A description is given of how foundry engineering problems connected with the production of an 1,100-lb. magnesium drum casting were solved. The casting was required for making a cable drum able to pick up a load of 10 tons from the ground by means of an airplane, have the weight air-borne and equal to the speed of the tow plane in 6 to 10 sec., tow it to destination with the necessary control, and release it. Information is given about the construction of the pattern equipment and the methods used for the gating and risering of the castings. *Aluminum and Magnesium*, July, 1945, pages 18–20, 4 illus.

Cold Impact Extrusion of Aluminum Parts for Douglas Aircraft. J. R. Boston. An account is given of the results obtained by Douglas Aircraft Company, Inc., with the application of cold impact extrusion to the production of aluminum parts for aircraft. It is stated that after extensive research a number of parts were successfully extruded on an experimental basis and that a limited number of parts are now being manufactured on a production basis using standard punch presses. Research on the cold impact extrusion of aluminum parts was started because it was realized that the method would make it possible to produce, in a single operation, parts that required four or five operations when drawn from sheet aluminum, and also that certain parts could probably be extruded that could not be drawn. It is noted that the successful application of the practice suggests possible extensive changes in certain shop methods. *Machinery*, July, 1945, pages 138–147, 14 illus.

How We Engineered the Lockheed Shooting Star. C. L. Johnson. These notes outline the development program for the Lockheed XP-80 jet-propelled fighter, telling how the first P-80 was designed and constructed in 143 days, compared with the schedule limit of 180 days. Information is given about organization and direction of the project; assembling of personnel; locating and housing of the project; obtaining of tools; development of a master schedule and work-guide book; progress of the work; special design and engineering problems that were encountered; interrelationship of departments; cooperation with Wright Field; testing of the plane; and costs. A chart illustrates the experimental group organization that was created within the Lockheed engineering and experimental departments to expedite the design and construction of the Shooting Star. *Aviation*, July, 1945, pages 149–151, 3 illus.

Tumble-Burring on an Engineering Basis. Herbert Chase. The writer describes how the Pratt & Whitney Aircraft Division of the United Aircraft Corporation has standardized so-called "tumbling" procedures and improved tumbling barrels so that a wide variety of parts can be handled in a minimum of time and many hours of hand burring saved. It is stated that gears and threaded parts, as well as large and small castings, are successfully treated and that the edges are rounded uniformly. *Wings*, July, 1945, pages 1628–1631, 3 illus.

Willow Run's Production Achievement. Franklin M. Reck. A summary is given of production and employment facts with regard to the aircraft-manufacturing accomplishments of the Ford Willow Run plant during its 4 years of operation. This is supplemented by a brief review of the plant's history. Tables and charts illustrate the related statistics. *Aero Digest*, July 1, 1945, pages 44–46, 78, 4 illus.

Final Operations. Part II. G. Schlesinger. Concluding half of a two-part article dealing with the final machining operations for obtaining good surface finishes. Part II discusses polishing, buffing, and burnishing. It also describes the problems and techniques of chipless forming operations, such as drawing and rolling; honing processes; and superfinishing. Surfaces obtained by different methods of finishing are compared. *Aircraft Production*, July, 1945, pages 350–354, 13 illus.

Machining Operations in Building Superfortresses to Bomb Japan. Earl Delaney. It is noted that production methods developed during past years of Flying Fortress manufacture, as well as newly devised practices, are being used at the Seattle plant of the Boeing Aircraft Company to speed the output of Superfortresses. Some of the unusual operations in the machine shop are described, one of these being threading of long wing-flap retracting screws by means of a standard die head on a turret lathe. *Machinery*, July, 1945, pages 192–200, 14 illus.

Propellers

Propeller Plans for Power. Willard W. Parker. A study of the design fundamentals that must be taken into consideration when selecting the most efficient propeller for a given airplane. The several major propeller-design variables that affect the most efficient means of converting engine power to useful thrust are described. Effects of possible changes in the design characteristics are illustrated by a hypothetic case in which an airplane design is set up and various combinations of propeller diameter and number of blades are checked for propeller performance, with two basic blade designs utilized. *Skyways*, August, 1945, pages 42, 43, 76, 91, 8 illus.

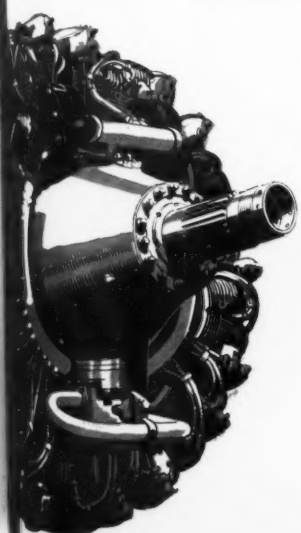
Radio

Increased Efficiency Claimed in New Radio Panel. Francis A. Spencer. Particulars are given about a proposed master radio control panel and microphone arrangement for air liners which has been designed by the writer. It is stated that the main objection to the present arrangement on many air liners is that at a critical point in the operation at least one pilot must divert some of his attention from the mechanical and navigational aspects of the flight to reach for various radio controls. The proposed panel has been designed to remedy this and other mentioned defects. *American Aviation*, July 15, 1945, pages 70, 72, 1 illus.

The Work of Panel E of the Canadian Radio Technical Planning Board. The functions, operating

MORSES'S TELEGRAPH • ONE MILLION HOURS AGO
COLUMBUS SAILED • FOUR MILLION HOURS AGO
LEIF ERICSSON • EIGHT MILLION HOURS AGO
CYCLONE 18 OPERATING TIME
TEN MILLION HOURS

Centuries of Power *behind the Constellation*



A year is only 8760 hours. The Wright Cyclone 18 has a total flight and test time of *ten million hours*. In hours, years or annual rings in a tree, that's eleven centuries of time.

In the war years, the Cyclone 18 has gone through a fast, grueling development program. No other engine has ever had to take such punishment — excess temperatures, overloads, overspeeding, lean mixtures and maintenance handicapped by supplies.

From that usage, however, came continuous refinement and design changes . . . improvements which paved the way for increases in performance not only of bombers, but of all types of planes powered by the Cyclone 18.

Thus, the Cyclone 18 built today for planes such as the Lockheed Constellation is the sum of this ten million hours of experience. The forced acceleration of war has produced an advanced engine, years ahead of its time, for all types of planes.

WRIGHT

AIRCRAFT ENGINES

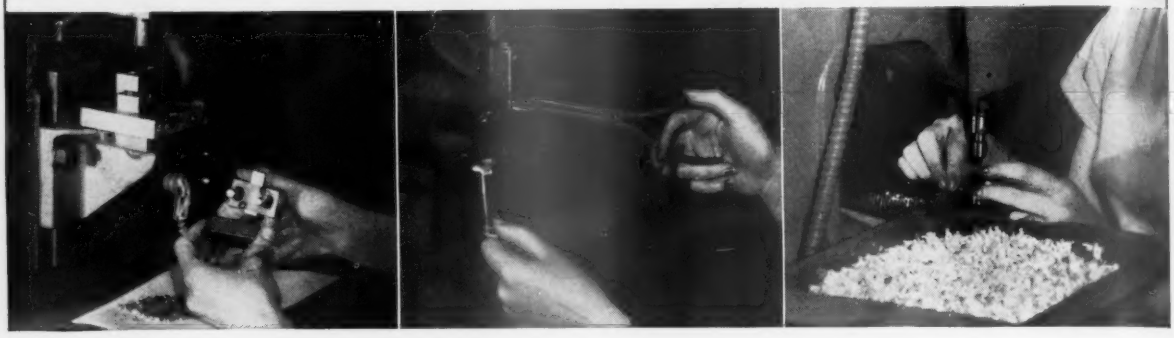
DIVISION OF

CURTISS WRIGHT

FIRST IN FLIGHT

Wright Aeronautical Corporation • Paterson, New Jersey, U.S.A.

5000 Designs for Millions of CONTACTS and CONTACT ASSEMBLIES



DURING the past 22 years, Mallory engineers have created more than 5000 designs for electrical contacts and contact assemblies. Meanwhile Mallory metallurgists have provided improved contact materials . . . special alloys such as Elkonite* and Elkonium* as well as combinations of silver, tungsten, platinum and other metals.

Mallory has also developed many special alloys for contact backings and such supporting members as springs, arms, studs and brackets. Modern production equipment enables skilled Mallory workers to torch braze, furnace braze, induction braze, resistance braze, silver solder, spot weld, projection weld, flash weld, spin, rivet or stake contacts to supporting members.

Having available this wealth of *design* data . . . of contact and contact assembly *materials* . . . and of *production facilities* . . . Mallory has been able to meet the most exacting requirements for millions of contacts and contact assemblies. Manufacturers of relays, industrial controls, business machines, home appliances, circuit breakers and a wide variety of electrical and electronic equipment have learned to rely on Mallory as Contact Headquarters.

Consult Mallory contact engineers while your product is being designed . . . *before* final blueprints are made. Often a complete contact assembly from Mallory will save you engineering time and production costs.

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

*Reg. U. S. Pat. Off. for electric contacting elements.

ELECTRICAL CONTACTS AND CONTACT ASSEMBLIES

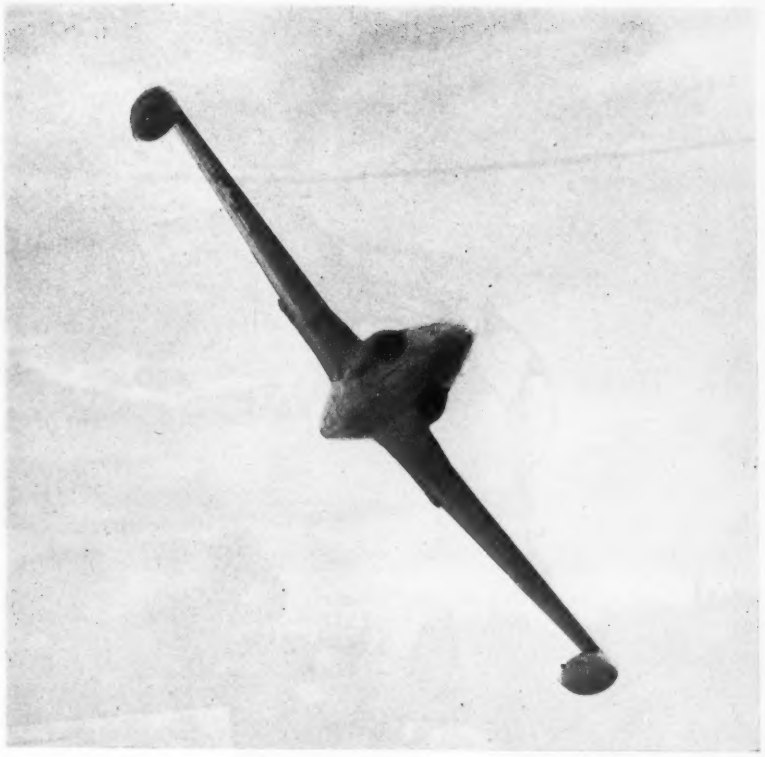
methods, organization, and social and economic importance of Panel E of the Canadian Radio Technical Planning Board are described. As related, the activities of this panel comprise analytical studies of technical problems arising from the immediate and long-term requirements of commercial aeronautical communication systems and marine and aeronautical navigation aids. Upon completion of these studies specific recommendations are made to the Board covering frequency allocation, functional standards for equipment, and other factors as they relate to both domestic and international applications of such commercial aeronautical and marine systems. It is stated that, in recognition of the desirability of international standardization, the Panel in its investigations makes the fullest possible use of the findings and recommendations of the Radio Technical Planning Board of the United States. *Commercial Aviation*, June, 1945, pages 55, 56, 60, 1 illus.

Reaction Propulsion

Reaction Propulsion Research in Poland. Z. L. Krzywoblocki. Theoretic and experimental investigations of rocket power as applied to aviation, conducted by the writer since 1933, are reviewed. The investigations referred to rocket and jet propulsion of the whole airplane; auxiliary jet propulsion during take-off and landing; and rocket projectiles launched from the ground or from the airplane. The results of the investigations are discussed. *Journal of the American Rocket Society*, June, 1945, pages 1–4.

Aeronautical Supremacy Demands Jet and Rocket Research. Part I. Roy Healy. First part of a continued article stressing the importance of rocket research and indicating future trends of development in this branch of aeronautics. Beginning with a brief account of how present research on jet-propelled devices is conducted, the writer describes the technical trends that are to be expected both for the remainder of the war and in any postwar program. He discusses fundamentals of the following weapons, citing the devices as the focal points of most further development: aircraft rockets, antiaircraft rockets, rocket-accelerated bombs, rocket torpedoes, and ground force rockets. Expected technical trends are summarized as: first, an increase in range, accuracy, and lethal effects of the many existing rocket weapons; second, introduction of directional controls in the larger long-range missiles. *Aviation*, August, 1945, pages 152–154, 4 illus.

What Makes the Rocket Go. Volta Torrey. Latest developments in rocket propellants are described and details are given about their manufacture and the principle on which they are designed. It is explained that the long rodlike grains of modern rocket fuel are cruciform in cross section so they will burn at an even speed. *Popular Science*, August, 1945, pages 68–71, 214, 218, 9 illus.



The Lockheed P-80 Shooting Star in flight. Auxiliary droppable fuel tanks are attached to the wing tips to increase the range of the craft.

First Facts on Nazi Jet Engines Show High Efficiency, Poor Metal. Based on obtainable information, comments are made about German jet-propulsion gas turbines. Some features of the Jumo 004 axial-flow jet unit are described. It is stated that engineers and technical military experts are generally agreed that the 004 unit is well designed and efficient but, owing to a lack of highly developed heat-resistant metals, a necessity for successful gas-turbine operation, its operational life is extremely short. Brief particulars are given about other German jet engines. *Aviation News*, July 23, 1945, page 26.

The Repulsor Rocket. A. E. Crawford. It is noted that the repulsor rocket, although capable of flight, is most convenient for use as a test bed for rocket motors. A description is given of a British experimental design of repulsor rocket, which is a modification of a German design. *Journal of the American Rocket Society*, June, 1945, pages 6–8, 2 illus.

German Jet Aircraft. G. Geoffrey Smith. A brief summary of the status of German progress in the reaction-propelled aircraft field at the time the European war ended. Brief details are given on Junkers, Heinkel-Hirth, and B.M.W. propulsion units as well as on several German jet planes. The aircraft noted include: the Me 163 and 262; the Arado 234; the unperfected Me 264, a four-turbine jet bomber intended for high-altitude, high-speed service; and an experimental fighter equipped with an intermittent impulse thermal duct engine, probably the Dornier Do 17Z. The article also reports a statement that two specimens of Germany's latest jet-propelled aircraft, twelve turbine engines, and rocket units, accompanied by German engineers, were sent to Japan in January, 1945. *Flight*, June 14, 1945, pages 631–633, 7 illus.

Research

Ranging the Budget in the Postwar Laboratory. Part VII. K. R. Jackman. The seventh article in a series interpreting the meanings, values, and problems of research as they relate to the aircraft industry is concerned with the financial planning for aircraft research laboratories. It considers the factors of laboratory budgeting. Two systems of cost control, "docket" and "case," are described and the merits of each are compared. Job classifications and salary ranges in aviation testing and research laboratories are discussed, with personnel distribution exemplified by an account of the setups in three typical aircraft laboratories. Some suggestions are offered also relative to gaging research needs for future aircraft markets. *Aviation*, July, 1945, pages 158–162, 5 illus.

German Aircraft Research Seen Far Ahead of Allies. Based on information gathered from the returning military and technical missions to Germany, this article indicates the branches in which German aircraft development is believed to have excelled. Subjects discussed include aerodynamic research,

The "Egg-Beater".. NEWEST HELICOPTER OF THE AAF

With twin 3-bladed rotors intermeshing like the blades of an egg beater, the Kellett XR-8 presents a new and novel design in helicopters. A purely experimental model built for the Army Air Forces, the XR-8 has the advantages of greater power efficiency, reduction of vibration, reduced drag, and reduced power transmission requirements.

Reports from test pilots indicate that it is highly maneuverable, and since the rotors revolve in opposite directions, there is no need for a tail rotor to counteract torque. While no performance figures have been released, the ship is powered by a Franklin air-cooled 245 h.p. engine using CECO fuel pumps.

Chandler-Evans is proud to have a small part in this new step in helicopter development. And as Chandler-Evans has always kept abreast of the newest and latest in America's other great war planes, so will it continue to serve the aviation industry when once again it turns to peacetime production.

The Kellett XR-8 has all the remarkable helicopter characteristics of vertical rise and descent, ability to hover, and to fly backwards and sidewise as well as forwards. (Kellett Aircraft photo).

CECO

CARBURETORS
FUEL PUMPS
PROTEK-PLUGS

CHANDLER-EVANS CORPORATION

SOUTH MERIDEN
CONNECTICUT, U.S.A.

undersea and liquid-type rockets, and winged artillery missiles. *Aviation News*, July 30, 1945, pages 34, 35.

Rotating Wing Aircraft

Principles of Rotary Wing Aircraft. Part IV. Alexander Klemin. The fourth section of a continued article deals with the rate of climb and ceiling in vertical climb, in connection with rotating wing aircraft. Mathematical expressions are derived and explained for the vertical-climb ratio, the induced velocity, and the thrust coefficient. From these expressions, formulas are worked out for the loading factor and the variation of the loading factor with altitude. Numerical examples are given to show the application of the expressions. In a similar manner explanations and examples are given for calculating vertical climb; maximum weight in relation to disc loading and ceiling; expressions in hovering and vertical climb; variation of blade angle of a rotor with constant pitch at one setting; coefficients for a constant-pitch rotor with varying profile drag; approximate expressions for constant-chord, constant-incidence rotors; initial rate of vertical climb at sea level at varying r.p.m. and full throttle; effect of changing r.p.m. at full power; and effect of change of solidity ratio on initial rate of climb. Conclusions are summarized under ten headings, and five practical problems are propounded by the writer to be solved by the reader. Results of the examples are tabulated, and a chart provides the means for determining the absolute ceiling of a helicopter in hovering flight. *Aero Digest*, July 1, 1945, pages 80–82, 84, 86, 146, 148, 2 illus.

Stress Analysis

Resistance Wire Strain Gage Applications and Circuits. E. G. Van Leeuwen and W. F. Gunning. A detailed discussion is given of application techniques and problems connected with the making and mounting of resistance wire strain gages for stress-strain analysis. The information is based on studies carried out at the research laboratories of the Douglas Aircraft Company, Inc. Strain-gage circuits that are sensitive to stretch, bending, shear, torque, pressure, and displacement are described. *Product Engineering*, July, 1945, pages 442–449, 16 illus.

Superchargers

Superchargers to Raise Power and Lower Cost of Lightplane Engines. E. W. Wasielewski. In a brief review of the trend of supercharger applications to Diesel and gasoline engines, the possibilities of employing mechanically driven positive-displacement type superchargers for light-plane engines are reviewed. Benefits of higher horsepower and lower cost to be gained through the use of superchargers for small airplanes are indicated. It is also explained why this type of supercharging offers advantages over other types for the particular application. *Aero Digest*, July 1, 1945, pages 114, 115, 164, 2 illus.

The PV-3 helicopter, manufactured by the P-V Engineering Forum, Inc., is being developed for the Navy and Coast Guard for air-sea rescue and special transport work.

Testing

Test Flying. Squad. Ld. J. R. Tobin. In an introduction to the main subject of this article, the writer explains the difference between the terms "test flying" and "flight testing" and classifies test pilots under three main headings—namely, pilots who actually test aircraft; pilots who do final inspections; and pilots who use the aircraft as a vehicle for the testing of equipment, engines, etc. Consideration is then given to the testing of actual aircraft, the most important branch of which is stated to be prototype work. The necessary qualities a test pilot should have are listed and discussed. The subject of aerodynamic experimental and research flying is discussed in sections dealing with medical-research flying, enemy-aircraft testing, and compressibility. *The Journal of The Royal Aeronautical Society*, June, 1945, pages 343–352.

Sunderland's Fast Flight. An account of the recent development work that has been done on the Sunderland flying boat also indicates the improved speeds that have resulted from the progressive modifications. In evidence of the speeds achieved, the stages and times of a recent record flight from Karachi to the United Kingdom are reported. *Flight*, June 7, 1945, page 607.

Tools and Equipment

Surface Measurement. Particulars are given about the functioning principles, construction, and operation of an optical analyzer for measuring reflective surfaces. Developed by the Pitter Gauge and Precision Tool Company, Ltd., this portable optical meter incorporates in one unit a light source, an optical system, and a reference lens by means of which use is made of interference fringes of light for producing a series of bands. The bands follow exactly the minute differences in the surface under test, presenting highly magnified (although distorted) pictures of the contours. It is claimed that this method ensures absolute accuracy of surface measurement, since there is no possibility of errors due to mechanical defects or electrical faults because the series of bands are self-calibrating. *Aircraft Production*, July, 1945, pages 307, 308, 3 illus.

Improved Profilometer. The type Q Profilometer for the measurement of surface roughness is described. Representing a reported improvement over preceding Profilometer modes, the type Q is portable and gives readings of surface roughnesses measured in microinch units.

Furnished with the type Q Profilometer is a type M tracer, the design and operation of which are also explained. *Aircraft Production*, July, 1945, page 339, 1 illus.

Training

Air Colleges are Coming. James A. Dennis. A regular aviation college course is proposed in which the student would be qualified for a commercial pilot's license, instrument rating, and instructor's rating upon graduation. The recommended plan calls for the actual flying training to be given by flight service operators in the immediate vicinity of the college or university at which the student is studying for his degree.

FOR AIRCRAFT ENGINES...AN AIRCRAFT SPARK PLUG

IN the world of tomorrow giant airliners of the Pan American World Airways System will girdle the globe. These huge ships of the air are already on the way to realization. They will represent the latest developments in speed, comfort—and, most important of all—in safety and reliability.

To assure these vital factors of successful airline operation, Pan American is using the most thoroughly proven equipment made. Spark plugs?

BG, *of course!*

THE BG CORPORATION
136 West 52nd St., New York 19, N. Y.

Manufacturers of both mica-insulated and ceramic-insulated aviation spark plugs.
Contractors to the United States Army, Navy and Coast Guard and Aircraft Engine Builders.

Through a coordinated arrangement with a group of colleges and universities, the number of students would remain constant so that the system could operate economically. In addition to suggestions regarding the schedules that would be followed, the article contains information about the costs of such education to an individual. It also offers a budget outline of the expenses of operating a coordinated flight school. *Skyways*, August, 1945, pages 28–30, 60, 82, 10 illus.

Apprentices—Skilled Labor Source. William F. Patterson. The writer deals with the apprenticeship training systems established in the aviation industry. While it outlines the broad pattern and basic standards followed by such systems in general, it also describes in detail one exemplary system—one adopted by Lockheed Aircraft Corporation. In addition, the article indicates the value of apprenticeship training programs, explains the effect of the military draft upon apprentice employment during the past few years, and discusses the career opportunities that will be open to war veterans through apprenticeship training. *Wings*, June, 1945, pages 1584–1586, 3 illus.

Para-Rescue. Jack DeLong. The purpose and training of the Royal Canadian Air Force Pararescue Division are described. Now being instructed at Jaspar National Park, this group is said to be specializing in a new kind of parachute jumping, deliberately making their practice rescue leaps into the tops of trees. The information given includes data about the organization of the pararescue training school, its sponsors, entrance requirements, etc. *Canadian Aviation*, July, 1945, pages 40, 41, 96, 98, 5 illus.

Warfare

The Ultimate Target. Some speculation upon how Royal Air Force heavy bombers will be used in the war against Japan. Among the alternatives presented, the one given greatest consideration is the possibility of employing Lancasters to bomb the Japanese mainland from bases within their range. The Marianas and Okinawa are indicated as likely locations for such bases. *Commercial Aviation*, June, 1945, page 74; "Allies vs. Japan," by Lucien Zacharoff, *Air News*, August, 1945, pages 21, 22, 66, 68.

Aircraft versus Battleship. B. A. Rabineau. The best conditions for bombing attacks on battleships are discussed with particular regard to the optimum size and weight of the bomb and the methods of bombing and the best overall efficiency of the whole operation, taking into account the vulnerability of the aircraft to the antiaircraft fire of the ship.

The "horizontal" and "vertical" methods of bombing armored ships are compared and analyzed. *Aeronautics*, July, 1945, pages 24–30, 8 illus.

Ramming is Suicide. Capt. Matthew Huttner. A discussion of the value and techniques of ramming. The tactic is appraised as a last-resource weapon that has been proved futile. It is stated to depend upon mentality rather than technique. The employment of ramming by the Germans and Russians, as well as the Japanese, is noted. *Air Trails*, August, 1945, pages 24, 25, 96–98, 1 illus.

Weight Control

Weighing and Locating the C.G. Part II. F. D. Porter and W. W. Holtz. This is the concluding installment of a two-part article on the determination of the weight and center of gravity of aircraft by means of weighing scales. The writers discuss factors involved in calculating the position of horizontal and vertical balance and the weights of trapped fuel and oil. *Industrial Aviation*, July, 1945, pages 24, 26, 27, 30, 98, 5 illus.

Why, How and Wherefore of Weight and Balance. B. J. Cumnock. The writer describes the essential features of a tested weight-control system. The system was developed to improve flight economy, eliminate tail-heavy and nose-heavy hazards, and lessen pilot fatigue. The procedures are described, and the forms and charts used are reproduced. *Air Transport*, July, 1945, pages 53, 54, 57, 58, 60, 8 illus.

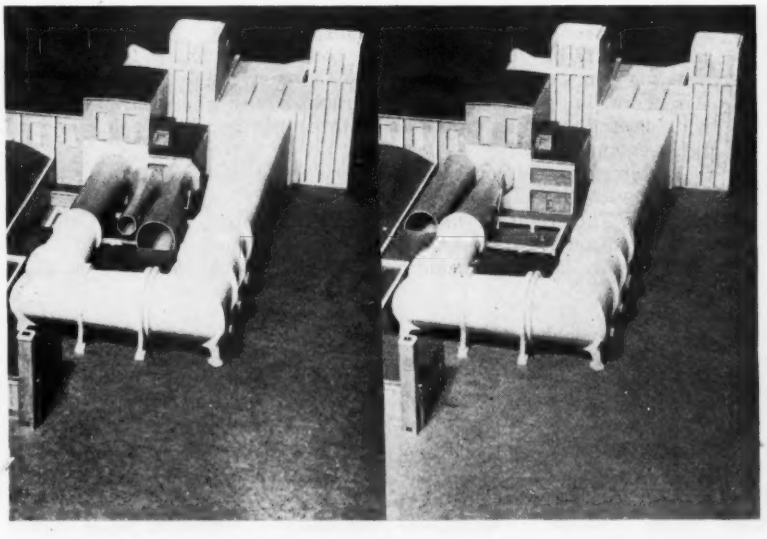
Welding

The Welding of Non-Ferrous Metals. Part V. E. G. West. Procedures for welding nonferrous metals and alloys are further discussed in this installment of a serial article. Following some remarks about metallic arc-welding techniques, the writer discusses carbon-arc welding, carbon-arc cutting, atomic hydrogen welding, argon-arc and heli-arc welding, and the Weibel and Rakos processes. Some advice is also given about the protection of the welding operator. *Sheet Metal Industries*, July, 1945, pages 1247–1252, 1256, 14 illus.

Miscellaneous

Aeronautical Section Reprint No. 11. Articles having a bearing on different phases of aeronautical engineering have been reprinted and compiled in a booklet of 34 pages and issued under an agreement between The Engineering Institute of Canada and The Royal Aeronautical Society. The titles of the articles and their authors are as follows: Aerodrome Construction in Saskatchewan, by G. T. Chillcott; Some Problems in Aircraft Production, by J. I. Carmichael; Plastic Laminated Wood in Aircraft Construction, by W. J. Jakimiuk; Air Transportation, by J. A. Wilson; Aircraft Manufacture, by Ralph P. Bell; Development of Post-War Aircraft, by James T. Bain; Some Design Features of the Mosquito Aeroplane by R. B. McIntyre; Plastic Plywoods in Aircraft Construction, by R. D. Hiscocks; The Post-War Possibilities of Air Transport, by Charles I. Stanton. *The Engineering Journal* (*The Journal of The Engineering Institute of Canada*), December, 1944.

Fire Safeguards for Magnesium. Robert S. Moulton. Information is supplied about proper methods of handling magnesium in plants to minimize the possibility of the occurrence of fire. Correct extinguishing techniques for magnesium fires are described. *Aluminum and Magnesium*, June, 1945, pages 20, 21, 24, 28, 29, 2 illus.



Two views of a model of the United Aircraft Corporation wind tunnel show, *left*, arrangement with 18-ft. test throat in use and, *right*, with 8-ft. test throat in place. The movable steel portion of the tunnel has been moved to the left, the small test throat has been wheeled inside the 18-ft. throat within the building, and the tunnel circuit has been completed by the diffuser section.

ROEBLING *Aircord*

COMPLETE DEPENDABILITY, whether for bomb hoist, or sure control on the bombing run—that's Aircord. It's one reason why most of the country's leading plane makers buy Roebling control cords.

When bomb carriers become common carriers, Aircord will again pay off . . . in durable, superior controls that require minimum maintenance and replacement.

Roebling control cords combine the finest materials with the skill of over a century of wire working. They're of stainless or high carbon steel with corrosion-resistant finishes. Several constructions are available . . . including Lock-clad, which minimizes unequal contraction and expansion of cord and frame.

Write for catalog of our line for the aircraft industry. Remember that Roebling engineers have worked with aeronautical engineers for over 30 years in improving control cord design; that engineering knowledge is always at your service.

Aircord Division

JOHN A. ROEBLING'S SONS COMPANY

TRENTON 2, NEW JERSEY

Branches and Warehouses in Principal Cities

ROEBLING

means Control in the air

AIRCORD • CONTROL CORD • STRAND

WIRE • TERMINALS • SWAGED CONTROL ASSEMBLIES • CONTROL CASING • WIRE ROPE • SLINGS • ELECTRICAL WIRES AND CABLES

Government Publications

Army Air Forces

Conveyor Belt System for Dropping Supplies. Installation of conveyer belt systems in Douglas C-47 cargo-carrying aircraft has decreased the time required for air crews to drop supplies to ground troops from 40 min. to a few seconds. The belt is similar to that used by industry. It is a chain-driven conveyer operated by a 3.87-hp. electric motor. Power is derived from the plane's 24-volt system. Extending from behind the pilot's compartment to the rear door of the plane, a distance of 22 ft., the belt runs at a rate of approximately 6 ft. per sec. The belt assembly terminates at a roller-bearing platform, mounted at the cargo door, which launches the containers from the airplane. Not only was speed in dropping achieved, but it was found possible to drop a load of 4,000 lbs. at one time, thereby reducing the number of passes over the target area.

Containers, each holding up to 300 lbs. of supplies, can be loaded two or three high on the conveyer belt. The belt itself is prevented from sinking with the load by means of rollers placed underneath. The containers are made of strong cotton duck and webbing or fiberboard and are known as "A-4" through "A-8," depending on the type of cargo carried. Parachutes are attached along with static lines, and, as the container reaches the door and is "nudged" out by means of the conveyer system, the static line automatically opens the chute. *Air Technical Service Command.*

China Checkerboard. This is a review of the activities of the United States 14th Air Force in China. It indicates the relationship between this Air Force's achievements and the war in China. *Air Force*, July, 1945.

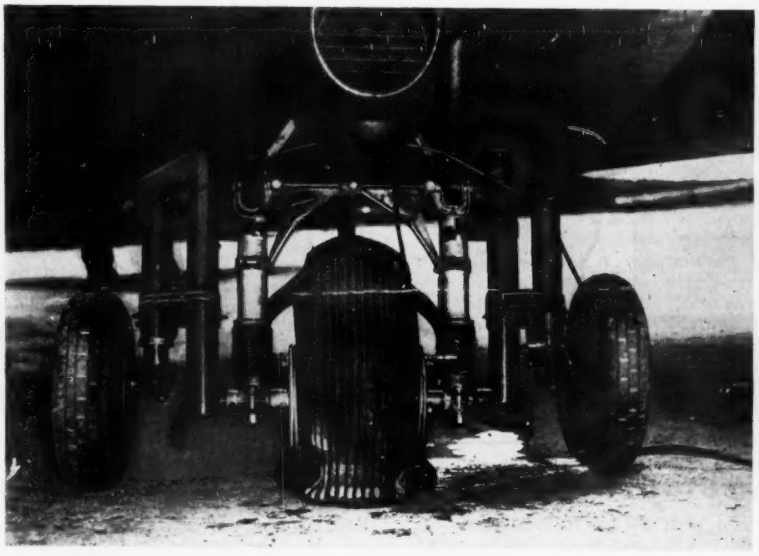
U.S. Tactical Air Power in Europe is the title of a special issue of the magazine *Impact* for May, 1945, which has recently been released from the list of restricted publications. It consists of nine special articles reviewing the tactical air war in Europe, centering largely around the operations of the 9th Air Force. Space considerations required that the scope of the article be limited. Therefore, the R.A.F. tactical effort has not been included and the Strategic Air Forces and R.A.F. Bomber Command enter the story only at points where their operations had an obvious bearing on the immediate tactical situation.

Numerous aerial photographs show the damage inflicted on the enemy's territory, and other photographs and diagrams illustrate various phases of the operations and help to clarify the detailed explanations given in the text. The titles of the nine articles are as follows: (1) Beginnings: The Advantages and Disadvantages Possessed by the Germans at the Start; Our Theory of Tactical Air Power; (2) The Early Air-Ground Lessons Learned in Africa; (3) A Year of Feverish Preparation for Normandy by the 9th AF in England; Attacks on Airfields, Rails, and the V-Weapon Sites; the Plans for D-Day and Pre-Invasion Operations; (4) The Invasion and the Days Immediately Following; (5) The Breakthrough at St. Lo and the Operations of the Tactical Air Forces in the Sweep Across France; (6) The Relationship of Tactical Air Forces to the Ground Armies While the Front was Relatively Static; the Tasks Performed by Radar; (7) Tactical Operations of MAAF—Anzio, the "Strangle," Air Aid to Russia, Sealing the Brenner Pass; (8) A Carpet Bombing Failure, An Analysis of the German Counter-Offensive in the Ardennes; (9) The Final Smash into the Heart of Germany. *Office of the Assistant Chief of Air Staff, Intelligence, Washington, D.C.*

Device for Moving Large Aircraft with Flat Tires. A practical and timesaving means of towing or taxiing C-47 or C-53 aircraft with flat tires, eliminating the necessity of changing the tire on the line or taxiing with a flat tire, was designed by a crew chief of a Troop Carrier Unit. By utilizing scrap parts, an auxiliary landing gear was fabricated and assembled in such a way as to be strong enough to lift one gear of a plane loaded to 33,000 lbs. and has an approximate safety factor of 4.

It was realized by the designer that the shock strut of a C-47, for instance, was neither designed nor intended to be loaded eccentrically to such an extent. However, computations revealed that a fair factor of safety may be obtained by canceling the bending moment imparted to the auxiliary shock strut by the horizontal reaction when the shock strut is fully extended and carrying one side of the airplane.

The installation and operation of the auxiliary landing gear lift is simple. The auxiliary landing gear is carried to the airplane with the flat tire. The main landing gear axle torque bolts are removed, and, with the auxiliary landing gear shock struts deflated, the axle of the latter is inserted in the axle of the airplane's landing gear, and the torque bolts are reinserted, holding the auxil-



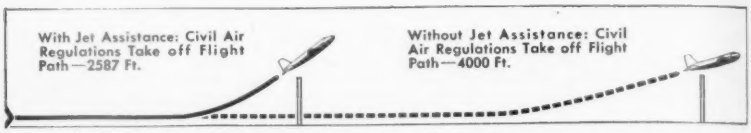
Photograph Courtesy Air Technical Service Command

The auxiliary landing gear which lifts C-47's or C-53's with flat tires to enable the airplane to be taxied easily for repairs.

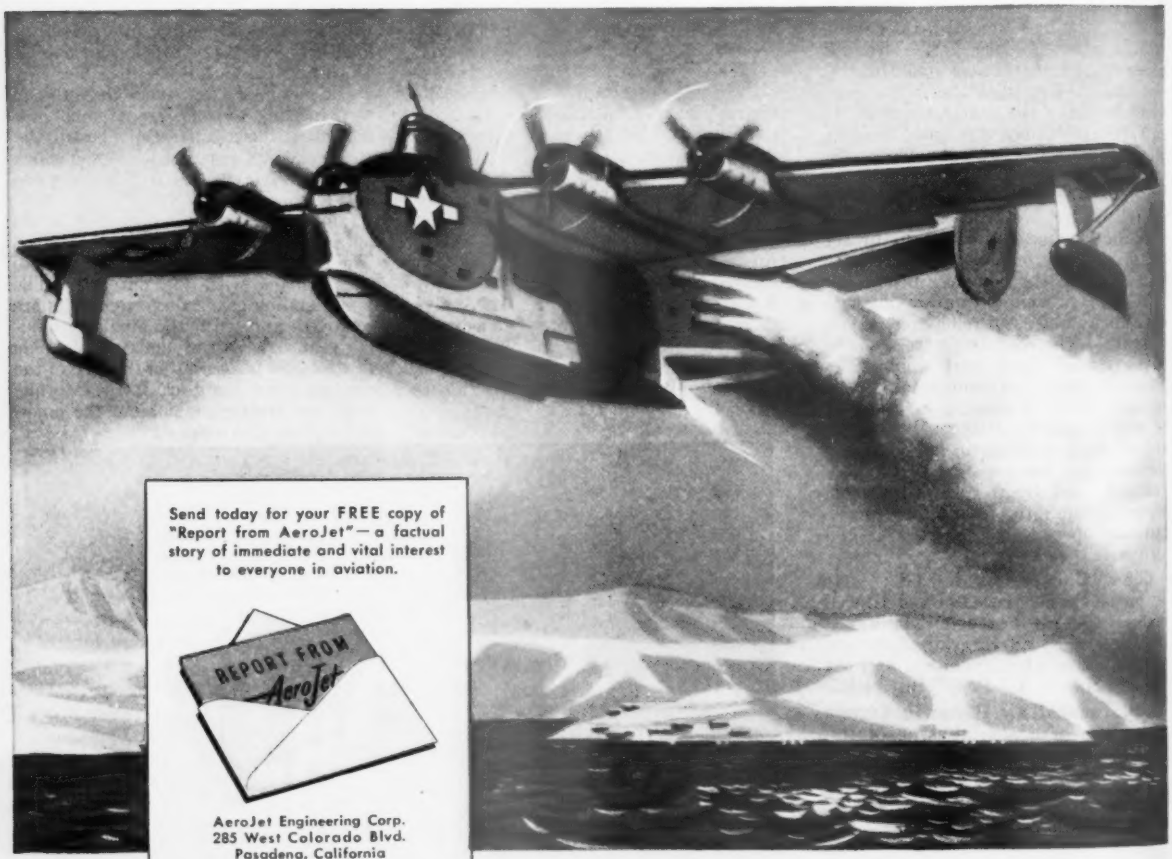
12 seconds of the most valuable time "on earth"!

Jet assisted take-off, born of war, will be commercial flying's greatest single aid when final peace comes. Directly adaptable to any type of airplane . . . capable of flying maximum payloads out of nearly any field at any altitude . . . Jet Assistance is the solution to the airlines' problem of getting profit payloads off the ground. The 12 seconds average thrust duration of AeroJet Assistance is worth much to the operator who looks to extra profits.

AeroJet Engineering Corporation has made many thousands of jet assistance units (Jatos) for the Army and Navy. Its research and development facilities are unequalled. AeroJet invites inquiries from any organization interested in learning more about this new science. An informative booklet—"Report from AeroJet"—has been prepared. Write for it today.


With Jet Assistance: Civil Air Regulations Take off Flight Path—2587 Ft.
Without Jet Assistance: Civil Air Regulations Take off Flight Path—4000 Ft.

DC-3 Analysis as Described in "Report from AeroJet"

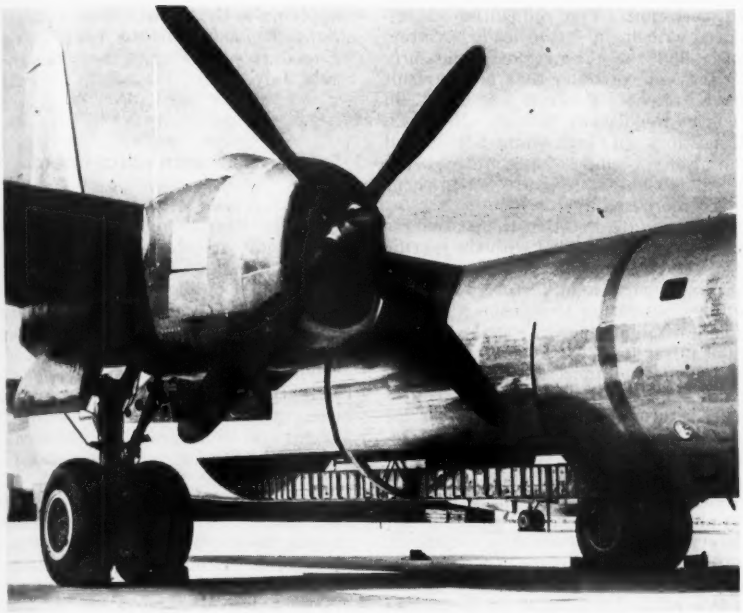


Send today for your FREE copy of "Report from AeroJet"—a factual story of immediate and vital interest to everyone in aviation.

AeroJet Engineering Corp.
285 West Colorado Blvd.
Pasadena, California

AeroJet Engineering Corporation • Affiliate of THE GENERAL TIRE & RUBBER CO.

THE POWER OF FUTURE AeroJet



Photograph Courtesy Consolidated Vultee Aircraft Corporation

Consolidated Vultee's B-32 Dominator is equipped with two bomb bays, arranged in tandem and located between the forward and aft cabins. The bomb bay doors are shown here in the open position. Also visible is the right main landing gear, with its dual 56-in. wheels which retract into the inboard nacelle.

iary landing gear in position. A balance line is connected from one auxiliary strut to the other. Next, the brake-bleed port fitting is removed from the wheel of the airplane and connected. Thus the outer wheel, the one with the greater leverage, is equipped with brakes operated from the cockpit.

The device is limited to C-47 or C-53 type airplanes, as other types have hydraulic lines through the hollow axles. These lines would have to be removed before the auxiliary wheels could be installed. *Air Technical Service Command.*

B-32 Details Unveiled by War Department. Featuring heavy fire power and bomb load, the B-32 was designed especially for operations in the Pacific. Although certain details are not yet available, it is known to carry sizable bomb loads for long distances at speeds exceeding 300 m.p.h.

It is an all-metal, high-wing, single-tail monoplane with a cylindrical, semi-monocoque fuselage and a modified Davis low-drag wing with fowler-type flaps. The tricycle landing gear, which uses dual tires, is fully retractable and has a completely swiveling nose wheel.

Power is supplied by four double-row, 18-cylinder Wright Cyclone engines of 2,200 hp. each, equipped with two exhaust-driven turbosuperchargers. The Curtiss four-blade electric propellers have a diameter of 16 ft. 8 in. and are equipped with Curtiss automatic synchronizers. Propellers on the two in-board engines have reversible-pitch blades for braking during the landing run.

The wing span of the B-32 is 135 ft.; the length is 83 ft. 1 in.; and the height is 32 ft. 2 in. It has a wing area of 1,422 sq.ft. and a gross weight of approximately 100,000 lbs. Overloaded, it weighs 120,000 lbs.; empty, more than 60,000 lbs.

The B-32 was developed by the Consolidated Vultee Aircraft Corporation in cooperation with the Air Technical Service Command and was built initially at the company's Fort Worth and San Diego plants. Since last May, however, limited production has continued at the Fort Worth facility.

Transition training for B-32 crew members, which was begun last February, is being provided by the A.A.F. Training Command at Fort Worth Army Air Field, Texas. *Air Technical Service Command.*

Redeployment in the AAF. Capt. Harry H. Ransom. An explanation of how the redeployment program will operate in transferring A.A.F. personnel from Europe to the Pacific, demobilizing those eligible for release, and maintaining an Occupational Air Force in Europe. Conditions of military readjustment are described and several specific questions concerning the program are answered. The information includes data pertaining to the 30-day rest "furloughs," reorganization of units, training of redeployed groups, educational and recreational programs for those who remain in Europe, and assignments in the United States. The point is stressed that the main purpose of the program is aimed at the quick defeat of Japan, with military necessity superseding all other considerations. *Air Force,* July, 1945.

Civil Aeronautics Administration

C.A.A. Offers Guide to Towns on Spacing Airports. To guide the thousands of communities now planning airports, the Civil Aeronautics Administration has issued a set of recommended standards for spacing between airports. The standards represent a revision of a tentative set circulated by the C.A.A. for comment by the industry, and in general are more flexible.

The most controversial requirement in the preliminary draft—that airports at which instrument (bad weather) operations are to be conducted simultaneously will require 14-mile separation from center to center—has been eliminated in favor of a general statement that they will require "sufficient separation from center to center to prevent conflict and overlapping in the holding and approach patterns during simultaneous instrument approaches."

In the case of smaller airports where flight is strictly "contact" (good weather) the earlier draft specified that traffic patterns should not conflict and stated that a Class 1 airport had a traffic pattern of 2-mile radius and a Class 2 airport had a $2^1/_2$-mile pattern. The final version merely offers "as a general guide" a radius of only 1 mile for the pattern at a Class 1 field, and 2 miles at a Class 2 airport. The "contact" traffic patterns of Class 3 and Class 4 airports—those used for scheduled transport operations—are considered to have radii of 3 miles and 4 miles, respectively, in both drafts. *Office of Aviation Information.*

CAA Intermediate Fields are Available to Communities. More than 200 airports in 41 states, now leased by the Civil Aeronautics Administration as intermediate fields, are available to communities for use as municipal airports. Any state, county, or municipal government can take over any of these fields if the community authorities agree to continue the field in operation in such a way that it is always available for emergency landings along the airways. Originally established as emergency fields by the C.A.A., these sites are essential airways facilities, and communities must agree to keep them available for emergency use. The C.A.A. has no objection to the city or town contracting with commercial operators for operation of the fields.

Most of these fields have turf runways; a few have paved runways, but none is equipped for fueling planes. Physical conditions of these emergency fields vary with locations, and there is no standard formula for their leasing by operators. Negotiations should be initiated with the Regional Administrator in the C.A.A. region where the airport is located. *Office of Aviation Information.*

Recommended Procedures for the Preparation of Aircooled Aircraft Engines and Accessories for Storage and for Service after Storage. The purpose of this release is to provide information relative to the best known procedures for the preparation of aircraft engines and accessories for storage and for service after storage.

It is anticipated that a steadily increasing number of aircraft engines and accessories that have been in storage for an extended or an indefinite period of time will be returned to service for use in civil aircraft. Some of these engines may need only minor servicing operations in order to prepare them for service use. Others, especially those where no record is available with regard to the specific treatment undertaken to prepare them for storage, will no doubt need more extensive servicing before they can be considered ready for service.

The records of the Aircraft Engineering Division contain a number of aircraft-accident reports in which the engine failed during the first flight of the aircraft after a period of idleness. In most cases, an examination of the engine after failure disclosed that internal rust, other corrosion, sludge, dirt, or oily ignition parts were the primary cause for failure. If proper treatment of the engines before these flights had been undertaken, these accidents probably would have been averted.

Engines that have been operated on leaded fuels are especially susceptible to corrosion. The difficulties experienced with engines using leaded aviation fuels and the precautionary measures to prevent corrosion that might result have previously been discussed in Safety Regulation Release No. 148. Conditions of high humidity, rapid variations in temperatures, and exposure to salt air also cause corrosion to occur much more rapidly.

It is not intended that the procedures outlined should conflict with the specific instructions issued by the various engine and accessory manufacturers on this subject but rather to serve as a general guide in the absence of specific instructions.

Recommendations for preparing engines for storage and for procedures when returning the equipment to service are listed under general headings referring to temporary storage for periods of 3 to 8 weeks and to extended or dead storage. A table is given listing materials found suitable in carrying out the precautionary measures described. *Safety Regulation Release No. 180, Aircraft Engineering Division*, May, 1945.

Procedure for Display of Identification Marks on Conventional Airplanes. This release is issued for the purpose of establishing a uniform method of displaying identification marks on certificated conventional-type aircraft as provided in Civil Air Regulations Part 43.102. It gives instructions regarding the location of the display, the lettering, and restrictions applying to the use of military insignia. *Safety Regulation Release No. 185, Flight Engineering and Factory Inspection Division*, July, 1945.

Civil Aeronautics Board

New Civil Air Regulations for Foreign Service. The Civil Aeronautics Board has adopted a new Part 41 to the Civil Air Regulations, *Certification and Operation Rules for Scheduled Air Carrier Operations Outside the Continental Limits of the United States*, effective on August 1, 1945.

The new part has been under consideration for well over a year and has been given careful attention by the Board and by the aviation industry, to whom the regulation was circulated in draft form for comment in October, 1944. Part 41 as finally approved is the result of study and discussion between the industry and the Board and the Civil Aeronautics Administration and will furnish the United States air carriers with a uniform and complete set of rules designed to promote safe and orderly operation.

The rules divide operations into two categories: "short-distance operations" and "long-distance operations." Short-distance operations are defined as those that involve intermediate stops of sufficient frequency to permit the dispatch from each stop to be based on spot

USAIG UNITED STATES AIRCRAFT INSURANCE GROUP

America's
Strongest Source of
Aviation Insurance

★

THE U. S. GROUP

★

Comprising 62 Leading
American Owned
Stock Companies

UNITED STATES AVIATION UNDERWRITERS
INCORPORATED
80 JOHN STREET
NEW YORK, N. Y
ATLANTA
CHICAGO
LOS ANGELES

Aircraft Engineers

★ ★ ★

The Beech Aircraft Corporation will keep the same reputation for designing and building outstanding airplanes as it has had before and during the war.

In accomplishing this, we offer the opportunity for permanent positions in an expanding organization to men with experience and above average ability on drafting, minor and major layout work and stress analysis. In applying send complete information on education and experience to the

ENGINEERING DEPARTMENT
BEECH AIRCRAFT CORPORATION
Wichita 1, Kansas

weather reports or a combination of spot weather reports and forecasts. Long-distance operations are those in which the time interval between stops is so great as to require that the dispatch be based entirely on forecasts of weather expected as the intended destination. In the former case a distinction is made between "day," "night," and "instrument" operation; in the latter the character of the operations is such as to make any distinction unnecessary.

All the requirements of this new regulation, which include maintenance, rules, and qualifications for pilots and crew, landing and take-off rules, flight and dispatching rules, etc., have been formulated to meet present conditions. The Board in approving the rules for application at this time is aware that they must necessarily be the subject of continuing study so that appropriate revisions can be made to meet new developments in this field.

Changes in War Air Service Pattern, October 2, 1944–April 1, 1945. A pamphlet of 10 pages contains maps of the United States on which are outlined the status of certificated routes as of April 1, 1945, and the schedules operating as of May 18, 1942, and April 1, 1945. It also contains tables giving statistics with regard to the allocation of transport aircraft, the plane-mile utilization before and after the establishment of the War Air Service pattern on May 18, 1942, and the numbers of multiengined transport aircraft owned by and available to domestic air carriers for scheduled operations at periods between September, 1939, and March, 1945. *Economic Bureau, Research and Analysis Division.*

Civil Service Commission

Opportunities in Federal Service for Mechanical and Aeronautical Engineers. The United States Civil Service Commission has announced a continuing need for mechanical and aeronautical engineers in the Federal service. Most beginning salaries are $2,980 or $3,640 a year, plus overtime pay, although some positions are filled at higher salaries and most positions are in Washington, D.C. Engineering experience is required for these positions, although appropriate education may be substituted for part of the experience.

Mechanical engineers are wanted to serve as ordnance engineers, heating and ventilating engineers, and plumbing engineers.

Aeronautical engineers are needed by the War and Navy departments and by the National Advisory Committee for Aeronautics and the Civil Aeronautics Administration. Some of the many interesting types of work in which they are engaged are: design and development of new or improved types of aircraft or aircraft equipment; wind-tunnel testing; stress analysis of airplane structures; and research and development on ultra-high-speed aircraft and self-propelled missiles. Experience must have been in aeronautical engineering.

Interested persons who are not now engaged in war work should write to the United States Civil Service Commission, Washington 25, D.C., for the illustrated folder *Mechanical and Aeronautical Engineers Are Needed in Federal War Agencies.* No written test is required for these positions. To apply, applicants should get Form 57 from the nearest first- or second-class post office or civil service representative, fill out the form completely, and send it to the United States Civil Service Commission, Washington 25, D.C. Federal appointments are made in accordance with War Manpower Commission policies and employment-stabilization programs.

Department of Labor

Reconversion Problems in the Buffalo Industrial Area. *Bulletin No. 804* of the U.S. Bureau of Labor Statistics consists of a report of the reconversion problems in the Buffalo industrial area, prepared by the Bureau's Productivity and Technological Development Division. The survey, encompassing 40 companies providing about half of all the manufacturing jobs in the area, indicates many types of readjustment problems for which solutions must be found. It outlines postwar production and postwar prospects and possible cutback effects. Suggestions for Government action are offered. For sale by the Superintendent of Documents, Washington, D.C., $0.10.

Department of State

Agreement Between the United States of America and Denmark. *No. 430* in the Executive Agreement Series, this pamphlet sets forth the agreement between the United States and Denmark relating to air-transport services. The arrangement is for the operation of scheduled air-line services of one country in the territory of the other country, with both countries agreeing that operations over its territory by air-transport companies of the other country could not be refused on unreasonable or arbitrary grounds. *Executive Agreement Series 430.* For sale by the Superintendent of Documents, Washington, D.C., $0.10.

Employment Opportunities in PICAO. The Department of State announces that there will be a number of employment opportunities for qualified personnel in the Secretariat of the new Provisional International Civil Aviation Organization (P.I.C.A.O.). This organization was provided for in the Interim Agreement on International Civil Aviation, which was concluded at the Chicago Air Conference of 1944 and which came into force on June 6, 1945. The seat of the P.I.C.A.O. will be at Montreal.

While it is impossible to announce a definite list of available positions on the Secretariat or of the salaries to be paid therefor until the Council has met and taken formal action, it appears that there will be required persons skilled in the several technical specialties of aircraft airworthiness, the qualification and licensing of operating personnel, the facilities and organization of air routes including requirements with respect to airports, air-navigation aids, air-traffic control, wireless communications and signals, meteorology, aeronautical maps and charts, air-navigation notices, and other airway publications.

There will probably also be a need for personnel especially qualified in the analysis of the economics of air transportation; in the preparation of ac counting studies relating thereto; in the preparation and coordination of statistical material; in the law of air transportation; in considerations relating to the requirements of the customs, immigration, quarantine, and other Governmental services; and in operational phases of air transport.

Finally, it appears that the Secretariat will need certain administrative personnel qualified in the records and preparation of minutes of technical committees, in the preparation of suitable documentation and information for public release, and in accounting and financial control with respect to the organization's own affairs.

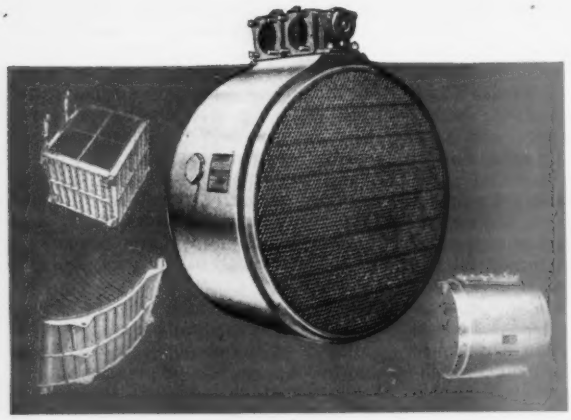
It is suggested that persons possessing qualifications described above and who are interested in securing employment with the P.I.C.A.O. communicate with Dr. Edward P. Warner, Vice-Chairman of the Civil Aeronautics Board, Washington 25, D.C., who has been designated as United States Representative on the Interim Council, enclosing a brief statement of qualifications.

A limited supply of application forms is available to members of the Institute at the Editorial Offices in New York.

National Advisory Committee for Aeronautics

Factors Affecting Heat Transfer in the Internal-Combustion Engine. P. M. Ku. A method was developed for the direct measurement of the average heat-transfer coefficient from gases in the cylinder during the cycle of operation of an internal-combustion engine. Experimental measurements were made with a heat collector projecting through a spark-plug hole into the combustion chamber of the test engine in order to examine the effects of several engine-operating and design parameters on the mean heat transfer to the collector.

For an engine of a fixed compression ratio and valve timing, operating with a given mixture ratio, with ignition adjusted to give maximum pressure at the same crank-angle position, the mean heat transfer was found to be a function of the air consumption only, no matter what changes the volumetric efficiency, inlet-air density, or mean piston speed might undergo. The heat transfer was found to vary with the 0.5 power of air



HOW ALUMINUM BRAZING RAISES SAFE TEMPERATURE-PRESSURE LIMITS OF HEAT EXCHANGERS

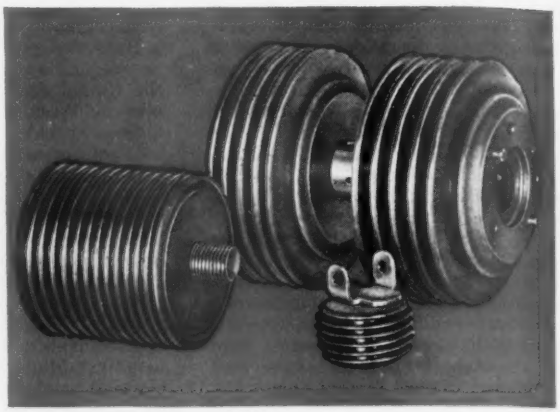
Until recently the temperatures and pressures which aircraft oil coolers and coolant radiators could withstand were limited by the annealing property of copper and the low melting point of the soft solder used to bond the tubes to shells and header plates.

Clifford's timely discovery of the method of brazing aluminum in thin sections enabled designers of several types of USAAF aircraft to meet temperature-pressure requirements, while saving ⅔ the weight of the replaced copper units. That was because:

1. Heat treatable aluminum tubes withstand working temperatures up to 275° F.
2. Heat treatable aluminum plates, shells and other parts stand up under temperatures and pressures that far exceed the failure point of other metals commonly used in aircraft oil coolers and coolant radiators.
3. High temperature aluminum alloy bonding material holds securely at temperatures several times higher than the point where soft solder fails.

WHAT CAN ALUMINUM BRAZING DO FOR YOU?

Clifford's patented aluminum brazing method, so successful for oil coolers and coolant radiators for USAAF fighting planes, is now being considered for use in the manufacture of heat transfer units for automotive, heating, cooling and ventilating applications. Your inquiry is invited. *Clifford Feather-Weights save ⅔ the weight . . . same size and shape.*



SYNCHRONIZING MOTION WITH BAROMETRIC CHANGES *ACCURATELY*

Today, aneroid or evacuated bellows assemblies are being widely used for automatic translation of changes in altitude or vacuum into motion required to operate valves and switches . . . to compensate for the effect of pressure changes on instruments and controls.

Typical applications are altimeters, oxygen-air mixture controls, absolute pressure recording and controlling instruments, header relief valves, supercharger boost controls, fuel and manifold pressure gauges, turbo-supercharger controls.

The spring rate of the bellows at the heart of each assembly is only as accurate as the wall thickness of the bellows. Since accurate wall thickness is inherent in the hydraulic method of forming bellows . . . pioneered by Clifford . . . accurately-calibrated, hermetically-sealed, acutely-sensitive Hydron Evacuated Bellows Assemblies are usually first choice. Given the total amount of travel (with allowable tolerance) Clifford will design, assemble, evacuate, seal and test the one right evacuated bellows assembly for you. Submit sketches and data before designs are too far advanced.

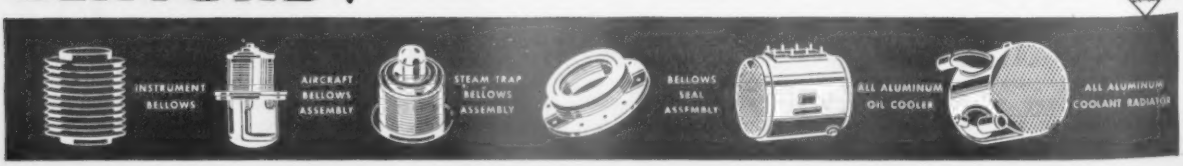
First with the Facts
on Hydraulically-Formed Bellows

CLIFFORD MANUFACTURING COMPANY
560 E. First Street, Boston 27, Massachusetts

CLIFFORD *Feather Weight*

OIL COOLERS AND COOLANT RADIATORS
HYDRAULICALLY-FORMED BELLOWS

HYDRON Metal Bellows



consumption in both a slow-speed and a high-speed C.F.R. engine. This figure was surprisingly constant for all tests.

The effect of the heat-resistive coating formed by the combustion deposits on the surface of the heat collector was also examined. Starting with a clean heat collector, the heat transfer fell about 20 per cent during the first 15 hours of operation, after which it fell off at a slow rate, becoming constant after about 40 hours of operation. *Technical Note No. 787*, December, 1940.

Some Investigations of the General Instability of Stiffened Metal Cylinders: *Part I, Review of Theory and Bibliography.* A series of reports gives the results of an investigation of the general instability problem by the California Institute of Technology. The first five reports of this series refer to investigations of the general instability problem under the loading conditions of pure bending and were prepared under the sponsorship of the Civil Aeronautics Administration. The succeeding reports of this series refer to the work done on other loading conditions under the sponsorship of the National Advisory Committee for Aeronautics.

The body of this report consists of three parts. The first part is devoted to the definition of terms and a general review of the problems involved in the study of the failures of thin stiffened shell structures. The second part deals with the strength properties of unstiffened sheets and cylinder, primarily because those investigators who have worked on the problem of stiffened structures have utilized the theories regarding unstiffened plates and shells as a background. A review and discussion of the available knowledge regarding the strength properties of stiffened cylinders which are subject to a general instability type of failure make up the third section.

Part II, Preliminary Tests of Wire-Braced Specimens and Theoretical Studies. The second report consists of three parts as follows: (a) Preliminary experimental investigations on the failure of stiffened metal cylinders; (b) theoretical investigations into the principles underlying the theory of failure of thin shells; and (c) experimental investigations on the compressive failing stress of unstiffened circular cylinder.

Part III, Continuation of Tests of Wire-Braced Specimens and Preliminary Tests of Sheet-Covered Specimens. The third report is concerned primarily with the continuation of the tests of wire-braced specimens and preliminary tests of sheet-covered specimens that had been made in the experimental investigation on the problem of the general instability of stiffened metal cylinders at the C.I.T. Tests have been completed on the first series of specimens. These specimens were constructed using one size of the frame and longitudinal and were given torsional stiffness by a wire network. A discussion of this type of specimen is given in Appendix B of the second report of this series. In this

set of specimens longitudinal spacing was varied from 2.53 to 10.12 in. and the frame spacing was varied from 2 to 32 in.

In addition to the previous set of specimens, four cylinders with the same size frame and longitudinal and covered with 0.010-in. thick 17 S-T dural sheet have been tested. A tentative correlation parameter has been found and is discussed more fully in the body of the report.

Part IV, Continuation of Tests of Sheet-Covered Specimens and Studies of the Buckling Phenomena of Unstiffened Circular Cylinders. This report deals primarily with the continuation of tests of sheet-covered specimens and studies of the buckling phenomena of unstiffened circular cylinders. An attempt has been made to correlate the experimental data of the wire-braced and sheet-covered specimens. A detailed discussion is given of the normal restraint coefficient. Ryder's theoretic work has been applied to three specimens. The results are tabulated and discussed in the body of the report.

In addition to the results on the sheet-covered specimens, the results of an investigation on axially loaded thin-wall metal cylinders is included in this report. As the preliminary work of this investigation was discussed in Part II, only results of the more recent work are included. An important finding of this investigation has been the determination of the initial wave form. It has been found that the initial wave form does not agree with the uniform sinusoidal type of wave which has been previously assumed for the theoretic solution but is elliptical in shape, scattered at random through the cylinder, and changes to a diamond shape as the load is increased. *Technical Notes No. 905, 906*, July, 1943; *No. 907, 908*, August, 1943.

The Effect of Inlet-Valve Design, Size, and Lift on the Air Capacity and Output of a Four Stroke Engine. James C. Livengood and John D. Stanitz. A series of performance tests has been made with a C. F. R. engine at constant inlet pressure and temperature and constant exhaust pressure. Special cylinder heads with different sizes and designs of inlet valve and port were used. The valves were tested at several lifts—both in the engine and in a steady-flow apparatus.

It was found that the variation of volumetric efficiency resulting from changes in valve design, size, and lift could be expressed as a function of the product of piston speed and piston area divided by the product of sound velocity, valve area, and average flow coefficient, provided that other design ratios and operating conditions were kept constant. The average flow coefficient was determined from steady-flow tests of the valve and port and from the diagram of valve opening against crank angle. The valve area was the area of the valve head based upon the minimum diameter of contact between valve and seat. Sound velocity was computed for air at inlet-mixture temperature. *Technical Note No. 915*, November, 1943.

Tests of Airfoils Designed to Delay the Compressibility Burble. John Stack. Fundamental investigations of compressibility phenomena for airfoils have shown that serious adverse changes of aerodynamic characteristics occur as the local speed over the surface exceeds the local speed of sound. These adverse changes have been delayed to higher free-stream speeds by development of suitable airfoil shapes. The method of deriving such airfoil shapes is described, and aerodynamic data for a wide range of Mach Numbers obtained from tests of these airfoils in the Langley 24-in. high-speed tunnel are presented. These airfoils, designated the N.A.C.A. 16-series, have increased critical Mach Number. The same methods by which these airfoils have been developed are applicable to other airplane components. *Technical Note No. 976*, December, 1944.

Experimental and Theoretical Investigations of Cavitation in Water. J. Ackeret. Translation of "Experimentelle und theoretische Untersuchungen über Hohlraumbildung (Kavitation) im Wasser," Eidgenössischen technischen Hochschule in Zürich (Berlin), 1930. The cavitation in nozzles on airfoils of various shapes and on a sphere are experimentally investigated. The limits of cavitation and the extension of the zone of the bubbles in different stages of cavitation are photographically established. The pressure in the bubble area is constant and extremely low, jumping to high values at the end of the area. The analogy with the gas compression shock is adduced and discussed. The collapse of the bubbles under compression shock produces extremely high pressures internally, which, according to more recent conceptions, are contributory factors to corrosion. The pressure required for purely mechanical corrosion is also discussed. *Technical Memorandum No. 1078*, May, 1945.

On the Automatic Regulation of Output in Centrifugal Compressors. V. F. Ris. Translation of Sovetskoe Koltloturbostroenie, No. 8, August, 1940. This paper discusses the theory and design of dynamic "pressure augmentors" (diaphragms, equal orifice plates, and nozzles) and various forms of "pressure multipliers" (simple venturi tubes, Rateau-type multiple venturis, and a combination of shaped nozzle and simple venturi developed by the writer). No complete theory of pressure multiplication is yet available;

...and what a show it will be!

We all anticipate the day when people will flock to exhibitions of new-model planes—*private* planes. "A world on wings" means something more than global air transportation. Revolutionary developments in communications and other electronic equipment—many of them born of war—will stimulate air travel generally. In this field, Western Electric is leading the way.

Buy all the Victory Bonds you can!

Western Electric

Distributed by Graybar Electric Company

RADIO AND OTHER ELECTRONIC EQUIPMENT FOR A WORLD ON WINGS

conditions of governing are discussed in relation to pressure-augmenting devices fitted either on the suction or the pressure side of the blower; fluctuations of output and power consumption caused by the presence of an augmentor are analyzed with the result that fitting on the pressure side appears generally preferable. Some considerations on the suitable design and selection of pressure-augmenting devices are appended. *Technical Memorandum No. 1081*, July, 1945.

Micromechanical Study of Metals. P. A. Velikov, N. P. Stchapov, and W. F. Lorenz. Translation of "Étude Micro-mécanique des Métaux," first communication of the New International Association for the Testing of Materials. In order that the results to be expected from the application of the micromechanical method may be judged, a discussion is given of several results on three different characteristic structures—namely, mild steel used in the construction of bridges, nontreated rail steel, and finely granulated chrome and nickel steel. The paper gives the micrographic characteristics of the three substances with respect to the development of permanent deformations produced by the tests.

The tests on the specimens for resistance to compression were carried out by means of the machine of Gagarine, while the tests on the resistance to tension were conducted on a special apparatus built by Lorenz. The Lorenz apparatus permitted stressing the specimen to the breaking point on the microscope stand itself. It is thus possible to observe in continuous fashion a certain group of grains during the entire stressing process—that is, up to the instant of failure—or to examine microscopically, at each stage of the deformation, the entire specimen under tension. *Technical Memorandum No. 1083*, July, 1945.

Navy Department

Airplane Structures, Aircraft Electrical Systems, and Advanced Work in Aircraft Electricity. These are three books of a series written to give enlisted Naval Aviation personnel the necessary information for performing their aviation duties. They were prepared by the Naval Air Technical Training Command and the Training Courses Section of the Bureau of Naval Personnel.

Starting with the basic principles of aerodynamics, *Airplane Structures* discusses the purpose of various parts of the airplane, the materials, and the construction. Following with information about fabric, metal, and plastic repairs, it also contains data on maintenance of flight controls, major assemblies and disassemblies, rigging, landing-gear maintenance, and corrosion precautions. A concluding section deals with the necessary inspections prior to flight.

Aircraft Electrical Systems is concerned with the fundamentals of aircraft wiring systems. It explains about starters, ignition, and spark plugs, and, in addition, investigates problems of aircraft power supply.

Recommended for those thoroughly familiar with the principles of electricity and aircraft electrical systems, the third book—*Advanced Work in Aircraft Electricity*—is a guide to the study of vacuum tubes, measuring instruments, and aircraft electrical instruments. It tells about Kirchoff's Laws, d.c. armature welding, and the theory of a.c. circuits. Information is given about motors, generators, and power transformers. This book also includes a section on electric propellers, electrical ordnance equipment, and aircraft electrical checks. *Bureau of Naval Personnel, Standards and Curriculum Division.* For sale by the Superintendent of Documents, Washington, D.C., *Airplane Structures*, $0.30; *Aircraft Electrical Systems*, $0.35; *Advanced Work in Aircraft Electricity*, $0.40.

Four New Navy Films for War Plant and Labor Union Showings. The Navy's latest industrial incentive motion picture, *Advance Base* is now available for showing to those engaged in war production work. Combat cameramen bring to the screen the story of the Seabees who have participated in every major amphibious invasion since the attack on Pearl Harbor. It is a stirring account of the Construction Battalions, who are shown landing after the first assault wave on a Pacific island; suffering heavy casualties along with the Marine Corps and the Army; and building airstrips, barracks, docks, and warehouses. Narrated by War Correspondent Quentin Reynolds, the film has a running time of 22 min.

Other films recently produced include the following: *Okinawa* (11 min.), a picturization of the early phases of the campaign to win the strategic island. It shows the rocket attack, the burning and blasting of the enemy's installations, the fury of Japanese suicide planes as they attack our ships offshore, and the vicious ground fighting that took place.

Your Mistake, Tokyo (6 min.) brings to the audience the tenseness of the "ready room" on board a fast carrier just before the take-off. Front-seat views show key Japanese cities being jolted from the air. It records the challenge of Radio Tokyo and the reply of Admiral Halsey: "Invade, overpower, exterminate!"

The Battle Ahead (8 min.), features an urgent message from Secretary of the Navy Forrestal and Admirals King and Nimitz on why there can be no letdown on the home front.

All of the subjects are available in 16- and 35-mm. size except *Advance Base*, which can be obtained only in 16 mm. The films are available from official Navy incentive film depositories located in or near production centers. *Navy Department, Industrial Incentive Division.*

Office of War Mobilization

Report to the Director of War Mobilization as to Activities under Executive Order No. 9425. One of the main sections of this report deals with aircraft, aircraft parts, and aeronautical equipment. It reviews the work and the reports of the Surplus Aircraft Advisory Subcommittee, the Working Committee, and the Aircraft Division, as well as the relationships of those organizations to the Reconstruction Finance Corporation and the Foreign Economic Administration. It gives detailed information about the purchase and sales procedures; the classes of aeronautical equipment designated as surplus property; and the policies established with regard to prices, inventories, public relations, and other matters. A summary of surplus aviation products as of October 17, and September 27, 1944, is given in tabular form. *Office of War Mobilization, Surplus War Property Administration.*

War Department

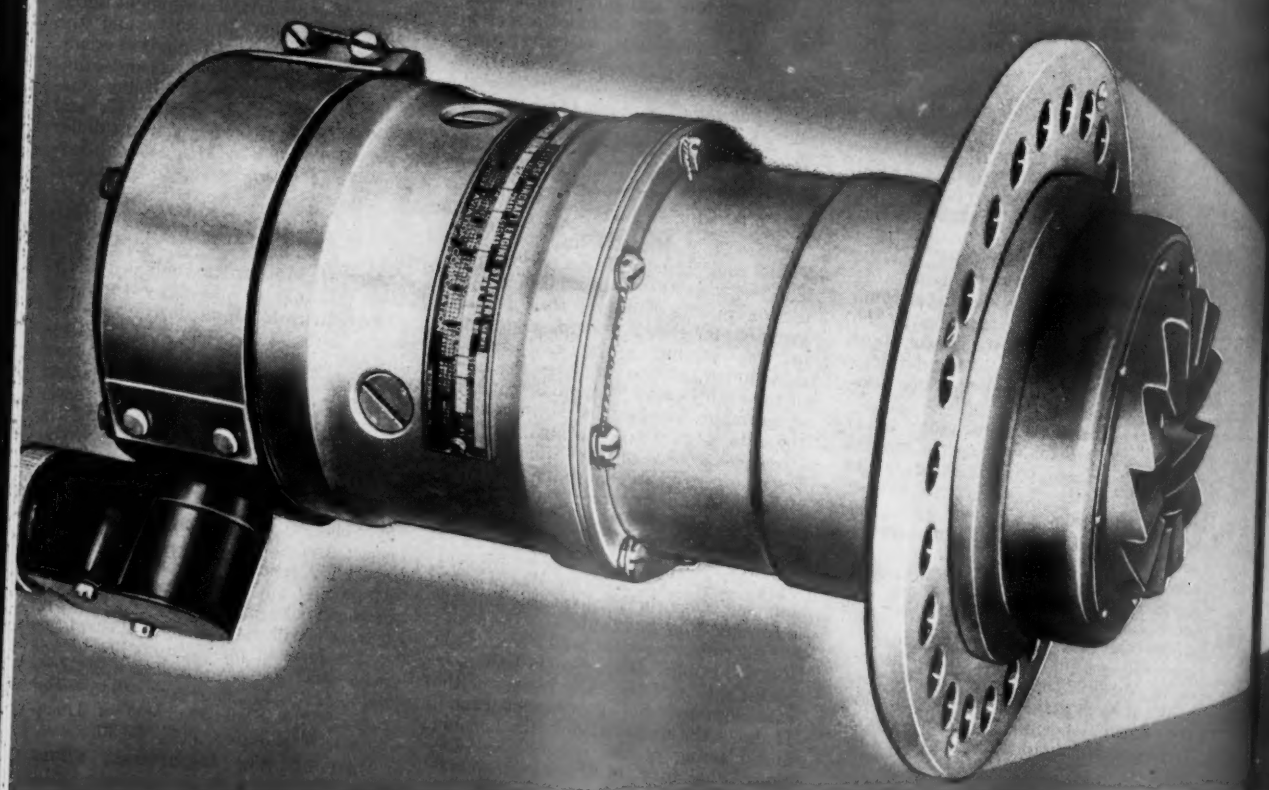
Aircraft Mechanics Tools is a Technical Manual prepared by the War Department for men desiring to become aircraft mechanics. It gives instructions for the proper use and care of aircraft tools, explaining when and how to use each tool and, in some cases, how the tool should not be used. It is written for men beginning to learn the work of an aircraft mechanic and also provides a review for men skilled in the use of tools. The tools are divided into five classes, with a chapter on each class: Assembly and Disassembly Tools; Special Aircraft Wrenches and Tools; Measuring and Layout Tools; Fabricating Tools; and Power Tools. The text is clarified by profuse illustrations in the form of photographs and drawings. *War Department Technical Manual TM 1-425*, February, 1945. For sale by the Superintendent of Documents, Washington, D.C., $0.30.

List of War Department Films, Film Strips, and Recognition Film Slides, is one of a series of manuals concerning instructional materials for military training. It deals with all major types of visual and audio-visual aids which are exhibited by projection and provides a complete list of such material available as of December 1, 1944. It states how these aids may be obtained and used effectively in military training. A large portion of the information listed refers to aircraft and aeronautical activities, and a special section of the manual gives lists of Army Air Forces film strips. *War Department Field Manual 21-7*, January, 1945. For sale by the Superintendent of Documents, Washington, D.C., $0.50.

List and Index of War Department Publications. This is a list of and index to War Department administrative, supply, and training publications. It also includes a list of forms stocked by adjutant general depots. The first sections of the manual tell about the training publications, numbering, distribution, changes, rescissions, cancellations, and supersessions. Then comes a list of the training publications, followed by an index. Other sections

LIGHTWEIGHT

Eclipse aviation e



DESIGN CHECK CHART FOR ECLIPSE TYPE 1416 AND 1423 LIGHTWEIGHT DIRECT CRANKING ELECTRIC STARTERS

APPLICATION:

✓ Eclipse Type 1416 and 1423 Direct Cranking Starters are designed to provide efficient direct cranking operation for engines of 200 to 3,000 hp.

✓ Type 1416 weighing 26 lbs. with a 6 in. mounting flange and 26¾ lbs. (average) with a 7 in. mounting flange is available for application to engines with 1:1 ratio of starter drive shaft to crankshaft.

✓ Type 1423 weighing 23.5 lbs. is available with 6 in. mounting flange for application to high output engines incorporating a 3:1 ratio of starter drive to crankshaft, and engines up to 450 hp., incorporating a 1:1 ratio of starter drive to crankshaft.

PERFORMANCE:

✓ The performance characteristics of the lightweight direct cranking starters are as follows:

	TYPE 1416	*TYPE 1423*
INPUT	24 volts DC	24 volts DC
CURRENT DRAW	165 amp. (at 400 lb. ft.)	185 amp. (150 lb. ft. at jaw)
CLUTCH SETTING	800 lb. ft.	375 lb. ft.
RATIO MOTOR TO JAW	133:1	43.5:1
JAW SPEED	49 r.p.m. (at 400 lb. ft.— 24 volts)	144 r.p.m. (at 150 lb. ft.— 24 volts)
ENGINE RATING	450 to 2,000 hp.	200 to 450 (1:1 ratio starter drive to crankshaft) and 2,000 to 3,000 hp. (3:1 ratio starter drive to crankshaft)

LET'S GO "ALL OUT" FOR VICTORY—
BUY MORE WAR BONDS

ECLIPSE
REG. U.S. PAT. OFF.

Eclipse

AVI

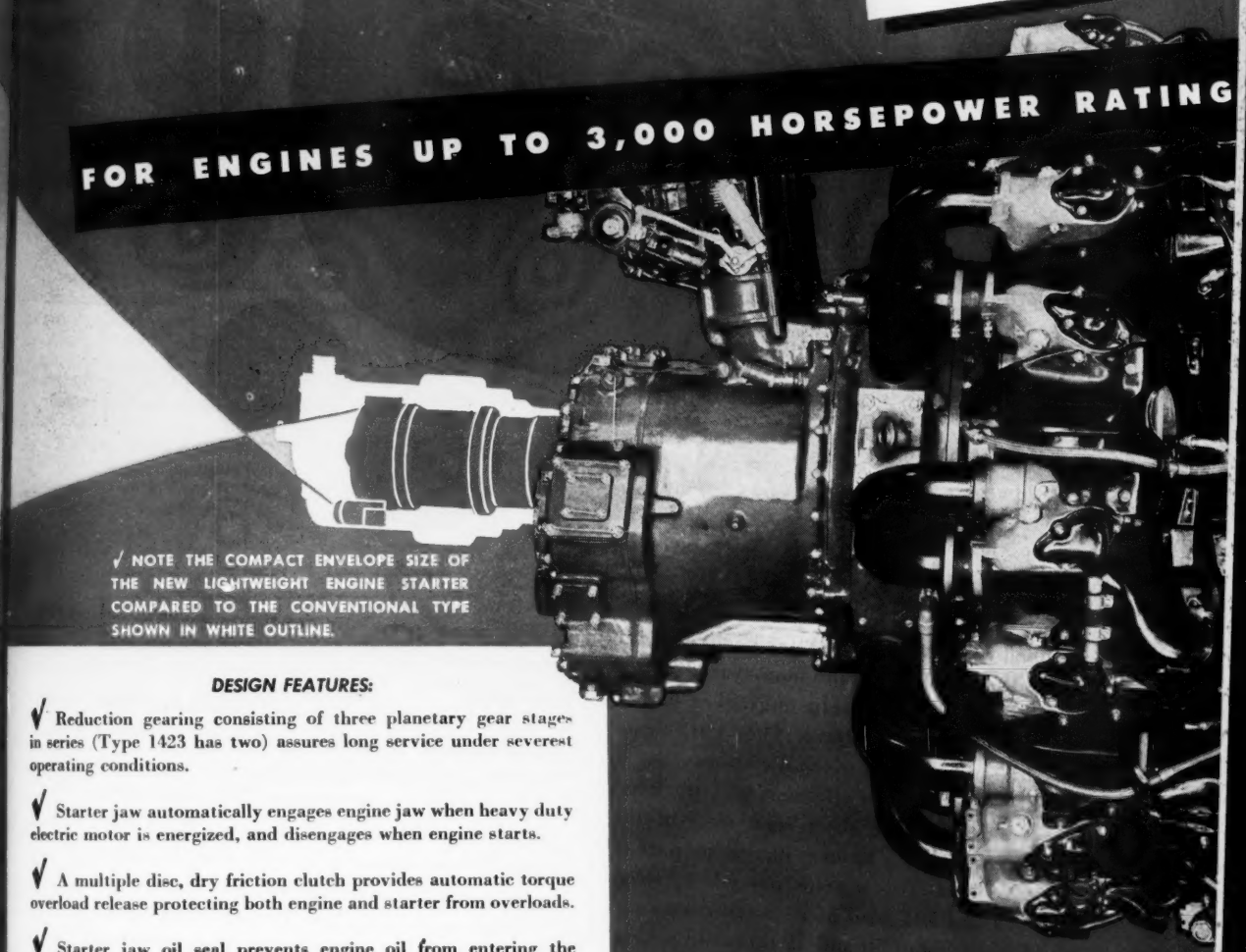
Eclipse-

on engine starter

ENGINEERING DATA

Starters
Previous Unit - 44 lbs
Type 1416 - 26 lbs
Weight Saving 18 lbs

FOR ENGINES UP TO 3,000 HORSEPOWER RATING



√ NOTE THE COMPACT ENVELOPE SIZE OF THE NEW LIGHTWEIGHT ENGINE STARTER COMPARED TO THE CONVENTIONAL TYPE SHOWN IN WHITE OUTLINE.

DESIGN FEATURES:

√ Reduction gearing consisting of three planetary gear stages in series (Type 1423 has two) assures long service under severest operating conditions.

√ Starter jaw automatically engages engine jaw when heavy duty electric motor is energized, and disengages when engine starts.

√ A multiple disc, dry friction clutch provides automatic torque overload release protecting both engine and starter from overloads.

√ Starter jaw oil seal prevents engine oil from entering the starter.

√ Grease lubricated starter parts; gears, ball bearings, etc., require no attention between periods of engine overhaul.

√ Design of starter housing permits speedy mounting or removal with conventional socket wrench.

AVIATION ACCESSORIES

PRODUCT OF Bendix

Eclipse-Pioneer Division • Teterboro, N. J. • Los Angeles 36, Calif.

Teamed with ARMCO Low-Alloy High Strength Steels these stiffeners (and many variations of their basic design) help engineers create lighter, stronger structures. They cut "dead-weight" and increase over-all efficiency.

Through the use of stiffeners and other improved designs, the sheet steel shell of the product now bears an ever-increasing part of the total load. This is made possible by steels like ARMCO 50Y and 55Y—with minimum yield strengths of 50 and 55 thousand psi. respectively. Designers of aeronautical equipment can increase the load the members will stand or use lighter gages with the same loads.

For some parts, lighter-than-conventional gages can be used without reinforcement of any kind.

Besides these advantages, ARMCO Low-Alloy High Strength Steels are easily fabricated and have excellent welding properties. Corrosion resistance of ARMCO 50Y and 55Y is considerably greater than that of ordinary steel. Where extra rust resistance is needed, zinc or aluminum coatings can be applied.

Write us for complete data on ARMCO Low-Alloy High Strength Steels. The American Rolling Mill Company, 761 Curtis Street, Middletown, Ohio.

EXPORT: THE ARMCO INTERNATIONAL CORPORATION

THE AMERICAN ROLLING MILL COMPANY

ARMCO HIGH STRENGTH STEELS

of the manual are devoted to administrative publications; tables of organization and equipment and similar publications; supply bulletins, modification work orders, and pamphlets; forms; and army personnel classification tests. *War Department Field Manual FM 21-6*, May, 1945.

British Information Services

British Commanders. This booklet contains short biographic sketches of 21 commanding officers of the Royal Navy, the British Army, and the Royal Air Force, arranged in alphabetical order. They have been chosen entirely on their prominence or the news at the time of writing—May, 1945. This explains the omission of some notable officers who would have been included if service seniority had been the criterion of selection. The sketches refer to Field Marshal Sir Harold Alexander, Field Marshal Sir Alan Brooke, Lt. Gen. F. A. M. Browning, Vice Admiral Sir Harold Burrough, Air Marshal Sir Arthur Coningham, Admiral of the Fleet Sir Andrew Browne Cunningham, Lt. Gen. Sir Miles Dempsey, Air Chief Marshal Sir Sholto Douglas, Admiral Sir Bruce Fraser, Air Chief Marshal Sir Arthur Harris, Lt. Gen. Sir Oliver W. H. Leese, Major Gen. Walter Lentaigne, Field Marshal Sir Bernard L. Montgomery, Admiral Lord Louis Mountbatten, Air Marshal Sir Keith Park, Marshal of the R.A.F. Sir Charles Portal, Major Gen. Thomas Reese, Lt. Gen. Sir William Slim, Admiral Sir James F. Somerville, Air Chief Marshal Sir Arthur Tedder, and Field Marshal Sir Henry Maitland Wilson.

British Air Ministry Translations*

The list below supplements those published in previous issues of the AERONAUTICAL ENGINEERING REVIEW.

Aeronautical companies and other organizations may borrow copies of these translations through the facilities of The Paul Kollsman Library upon application by the company librarian. Because of the importance of this material, the regular library loan period has been extended to two weeks, in order that these translations may be utilized to their full advantage. Requests should be made by number, author, and title on regular Library book request cards. Because of the many requests for these translations, no more than five copies may be borrowed at one time by one organization.

The translations have been reproduced from typewritten copy, and the number of pages in each is indicated at the end of each reference. Bibliographic information has been taken directly from the translations. Photostatic copies are also available at the usual library rates.

2422 Weber, H. *Measurement of phase shifts by using one ammeter.* Elektrotechnische zeitschrift, v. 63, no. 19-20, May 21, 1942. 2 p. An apparatus is described, having two scales for reading the power factor and absolute value of the current, for measuring the magnitude of the phase shift of alternating current with respect to the voltage.

2426 Kuhlenkamp, A. *Anti-aircraft sights. Part 1, General considerations.* Zeitschrift des Vereines deutscher ingenieure, v. 87, no. 37-38, September 18, 1943, p. 577–585. 16 p. The backsight and foresight, mirror telescope, sighting telescope, predictors, actual and apparent movement, calculation of deflection, and arrangement of sights are discussed. Only equipment for light anti-aircraft artillery of calibres up to 4 cm. is considered.

2428 Wolff, E. *The effect of rounding-off an originally sharp leading edge on the resistance of wings.* Ingenieur-Archiv, v. 4., no. 6, December, 1933; Part I, p. 521, Part III, p. 533–537. 10 p. The pressure distribution was measured on airfoils with sharp leading edges, fitted with end plates and suspended in the air stream of a free-jet blower with 40-cm. nozzle diameter, at a distance of 15 cm. before the nozzle, and at a wind velocity of 24 meters per sec. The measured pressure distributions were in generally good agreement with the theoretic curve. An eddy forms at the leading edge around which the normal flow passes, returning to lie against the surface behind the eddy. With a given angle of incidence, the maximum measured negative pressure corresponding to the eddy region at the leading edge is approximately constant for all curvatures. As the theoretic maximum negative pressure diminishes with increasing curvature, with a definite value of the curvature it equals the measured negative pressure. The eddy then vanishes. With smaller curvatures the flow must of itself furnish the lost curvature through the formation of the eddy. The more the body is rounded off, the smaller the resistance, as the smaller will be the proportion contributed by the eddy to the curvature necessary for the potential flow. Measurements of the air forces on a larger model airfoil, in a large wind tunnel, as determined by balances, are also reported.

2429 Sokolik, A. *Detonation and peroxides in the internal combustion engine.* Acta physiochemica U.S.S.R., v. 9, no. 3/4, 1938, p. 593–619. 15 p. The following are reviewed and discussed: the basis and experimental evidence for the peroxide theory of detonation in the internal-combustion engine; the cold flame and the detonation wave; the types of chemical activation of the mixture in the engine; diisopropyl ether as fuel for engines, including the effect of engine speed on its antidetonant properties; and the relationship of the cold flame and the detonating properties of fuels.

2431 Holzler, E., Gecks, and Kamphausen, G. *Transmission of amplitude- and frequence-modulated oscillations on short waves.* Elektrotechnische zeitschrift, v. 65, no. 15-16, April 20, 1944, p. 133–138. 10 p. Rapidly-alternating variations of volume and timbre, and distortions, in short-wave transmission can be reduced to a large extent by the adoption of the single-sideband method without carrier frequency. In using frequency modulation for a further reduction of noise, new disturbances occur in the form of distortion which is scratchy and may lead to unintelligibility. The conditions giving rise to these effects can be correctly derived qualitatively in all points and quantitatively in a large number of points, if z-path transmission is adopted. The phenomena are explained and their relationships are illustrated on a model circuit, on which tests reproduce the actual conditions faithfully. The model circuit also enables the influence of interfering transmitters in that vicinity to be ascertained by direct comparison.

2432 Colombi, C. *New curves of heat-energy transformation. The enthalpy-thermodynamic potential diagram and its applications.* Bulletin technique de la Suisse romande, v. 66, no. 14, July 13, 1940, p. 149–154. 8 p. Using the enthalpy-thermodynamic potential diagram, the isothermal and isentropic compression of atmospheric air and a superheated vapor, carbon dioxide, are compared. On the basis of the results graphically obtained, the author concludes that all the information needed for calculation referring to the two fundamental types of compression studied can be obtained through the diagram by simple reading and simple measurement, both for superheated vapors and perfect gases. Enthalpy-thermodynamic potential diagrams for atmospheric air, carbon dioxide, and ammonia are reproduced.

2433 Gurtler, H. *On an oscillation phenomenon in fluids with stable density stratification.* Zeitschrift für angewandte mathematik und mechanik, v. 23, no. 2, April, 1943, p. 65–71. 11 p. The theory of forced small oscillations in a frictionless fluid with stable density stratification under gravity leads to the prediction of a

* Selected translations are available in reprinted form (on 8½ by 11 paper) from the Durand Reprinting Committee, c/o Aeronautics Department, California Institute of Technology, Pasadena 4, Calif., at $0.05 per page. The translations are also available on a yearly subscription basis at $0.05 per page with a guarantee that not over 2,000 pages per year will be reprinted. As the cost of reprints varies as a function of the number of subscribers, this service will be available at $0.03 per page upon receipt of 23 more subscribers.

POWER

for aircraft cabin heaters and de-icers

WITHOUT RADIO INTERFERENCE

New

400-cycle, G-E ignition transformers that provide an unfailing 6000-volt arc

LIGHTWEIGHT: 13 pounds for largest rating (illustrated)

SMALL: Approx 10½ by 3¾ by 6¼ inches for largest rating (illustrated)

HIGH OUTPUT: 6000-volt secondary at 20 ma

Lighter and more compact than standard, 60-cycle oil-burner units, these ignition transformers for gasoline-fired cabin heaters and de-icers are designed to withstand the most severe flying conditions. They operate from a 115-volt, 400-cycle power supply, and deliver ample output current for positive and continuous ignition. Ordinary operating hazards —such as cold or fouled spark points —do not affect the efficient operation of these units. A new and improved method of shielding and filtering provides exceptional freedom from radio interference over all wave bands from 10 kilocycles to 200 megacycles.

Three ratings available—One has a single secondary for use on circuits where both primary leads must be insulated from ground; each primary lead is provided with a filter. Another unit (illustrated) has a double secondary for application on heaters with dual ignition, or for use with two separate heaters having single-ignition systems; one side of the primary is grounded. The third unit has a single secondary, and differs from the first unit in that one side of the primary line is grounded; thus, it requires only one primary filter, reducing the weight by 2¾ pounds. All units have a power factor of 90 to 95 per cent.

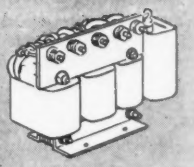
Wide range of operation—These new transformers are designed to resist moisture, heat, vibration, shock, and corrosion. They will operate successfully at any ambient from −70 to 140 F, at any altitude up to 45,000 ft.

For further information, ask for Bulletin GEA-4431. Or, for data on our complete line of aircraft transformers, write for Catalog GEA-4238. *General Electric Company, Schenectady 5, N. Y.*

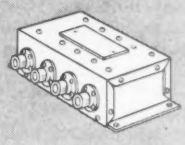
GENERAL ELECTRIC

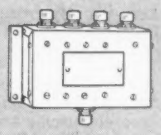
403-83-5219

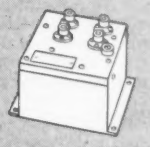
IMPROVE AIRCRAFT ELECTRIC SYSTEMS WITH THESE G-E TRANSFORMERS



3 to 1-phase, 2 to 3-phase, and 1 to 3-phase transformers







Transformers and ballasts for lighting indicators and instruments

Starting vibrators and ignition boosters

FOR THE WAR PLANES OF TODAY and THE COMMERCIAL PLANES OF TOMORROW

novel oscillation phenomenon. For frequencies below a critical value which depends on the density stratification concerned, the differential equation of the second order for the displacement amplitudes of oscillations harmonic in time as functions of the place coordinates, is of the hyperbolic type. Defects in the regularity of these quantities at one position accordingly appear at the same time also at all points of the real characteristics of the differential equation, passing through this position. Experiments with oscillations in a common salt solution of variable density are described, which confirm the predictions of the theory.

2434 Mann, P. A. *The time characteristic of noise voltages.* Elektrische nachrichten-technik, v. 20, no. 10, October, 1943, p. 232–237. 8 p. Mathematical methods are indicated which can be used with advantage for calculating the characteristics of noise, including the Dirac delta function. With the aid of this function, it was investigated whether amplitudes of the noise voltage occurring at different times have a causal relationship. A formula is given for the number of boundary values of an arbitrary amplitude value per unit of time as a function of the band width and of the root mean square of the voltage.

2436 Hetzel & Co., Vereinigte Silberhammerwerke, Nurnberg. *Cupal instruction sheet No. 2, Soldering and other methods of joining "Cupal."* August, 1939. 2 p. Cupal may be spot welded with an electronically controlled welding machine in cases where the aluminum sides of single-coated sheet are to be joined together or to aluminum alloy. In all other cases lap riveting or folding is recommended, and soft soldering for watertightness.

2437 Lorenz, H. *The bending of curved pipes.* Physikalische zeitschrift, v. 13, 1912, p. 768–777A. 8 p. A theoretic analysis is made of the stresses in curved pipe under bending.

2438 Weissfloch, A. *Application of the transformer theorem for non-dissipative quadripoles to series connected quadripoles.* Hochfrequenztechnik und elektroakustik, v. 61, no. 1, January, 1943. 27 p. The characteristics of a number of quadripoles connected in series are investigated, starting from the transformer theorem which states that any nondissipative quadripole, complying with the assumptions made regarding reversibility, can be considered an ideal transformer without any stray fields if it is completed at the input and output by sections of uniform line of the proper length. This analysis shows promising results when applied to the decimeter centimeter range, as, for example, the compensation of disturbances in a line, the setting up of variable transformers, and band filters and the compensation of sets of frequencies in impedances varying with frequency, such as in antennae. The quality attainable for transmission bands of band pass filters or for the compensation of sets of frequencies now remains only a question of the material expenditure.

2439 Joukof, I. I. *The interaction of nitrogen with metals at high temperatures.* Abstract only of article first published in Journal of the Russian Physical-chemical society, v. 42, 1910, p. 42–55. Bulletin de la Société chimique de France, Series 4, v. 10, p. 159–160. 1 p. The results are briefly presented of studies on the action of nitrogen on magnesium, calcium, aluminum, zinc, copper, iron, chromium, titanium, molybdenum, and vanadium at temperatures up to 1250°C.

2440 Schmid, G., and Roll, A. *The action of intense sound on molten metals, Part II.* Zeitschrift für elektrochemie, v. 45, no. 10, October, 1939, p. 769–775. 8 p. Low melting point Woods alloys, showing needlelike crystallites in section, were subjected, while solidifying, to the action of intensive sound or supersonic waves of frequencies of 50, 9,000 and 284,000 cycles per sec. and intensities of 1 to 40 watts per sq. in. The magnitude of the grain refining action of sound could be studied by the shortening of the needles, which increased with the intensity of sound. As frequency had no effect or an indefinite effect, it was concluded that the grain refining in the metal was due to frictional forces between the molten wax and the crystals that had separated out. A rough calculation indicated that the frictional forces due to the oscillations were in fact of the same order of magnitude as the strength of the needles.

2441 *Electrolytic welding.* Gas und elektrowärme, 1944, Part IV, p. 74–75. 1 p. An electrolytic method of welding is briefly described, using a vessel with a large metal plate at the bottom as an anode, and a cylindric sleeve at the top as a cathode, containing the parts to be welded. Hydrogen is formed, which envelops the cathode and an arc is struck. The metal melts and at this point the two parts are pressed together.

2442 Schmitz, F. W. *Aerodynamics of aircraft models. Aerofoil measurements. Part IV. Plotting the measurement results.* P. 71–102. 37 p. The lift perpendicular to the direction of the wind, the drag parallel to the direction of the wind, and the moment of rotation of the model were measured on selected model airfoils at various angles of incidence. After reduction these were plotted as nondimensional coefficients against the Reynolds Number. Airfoils studied were the Göttingen 625, a thin flat plate, a curved plate, and U.S. Navy N60 and N60R.

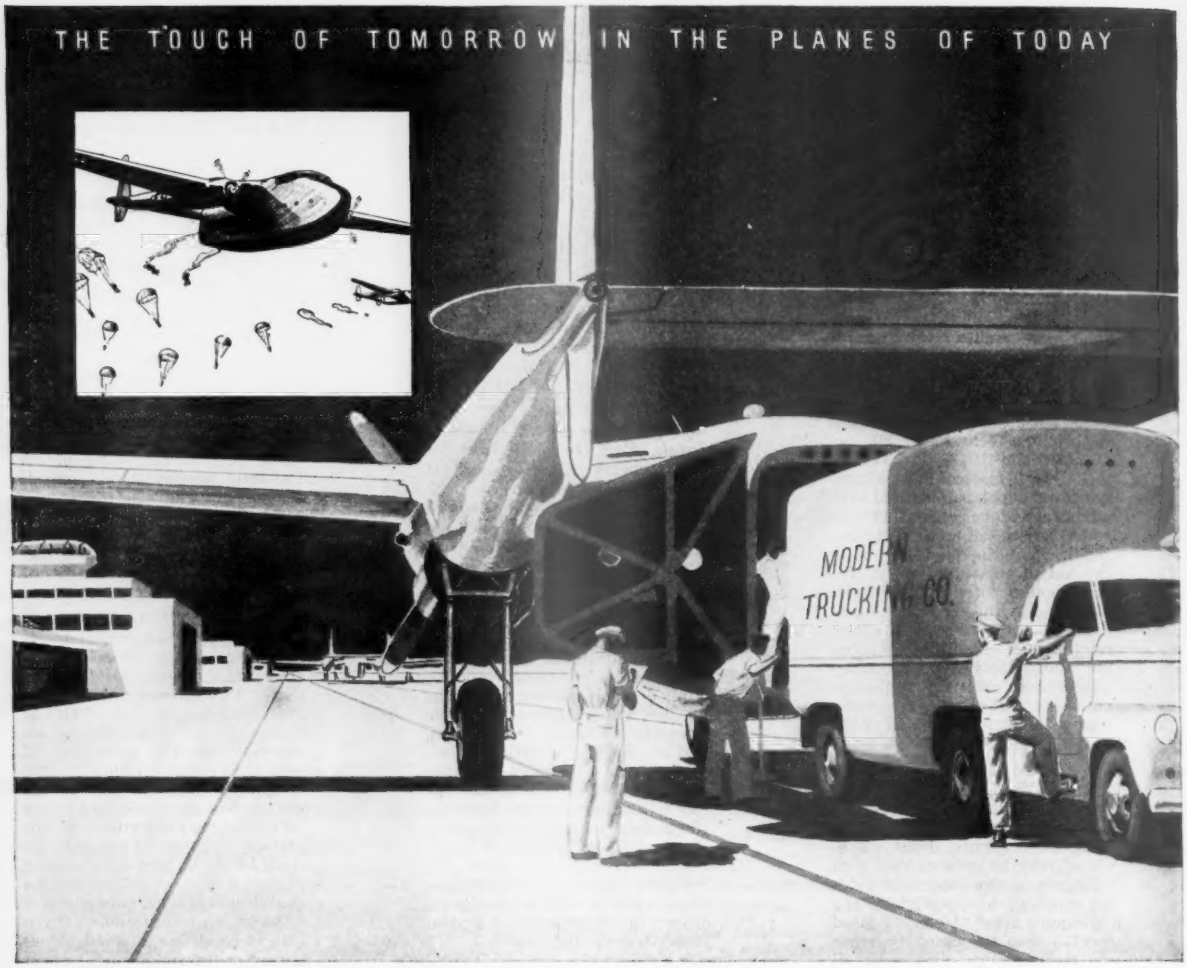
2443 Haller, P. de. *Photographic striation methods applied to the supersonic wind tunnel of the E.T.H., Zürich.* Eidgenossische technische hochschule, Mitteilungen, no. 8, 1943, p. 44–49. 4 p. An apparatus is described for use in applying the photographic striation method at supersonic speeds in a wind tunnel. The system, comprising source of light, prism, diffraction plate, and camera, is mounted on a common carriage and can be displaced in three directions by handwheels and spindles. The ease of handling due to close juxtaposition of adjustable parts, and the small number of optically exact glass surfaces, are cited as advantages of the arrangement. A method of determining the deflection of light at every point on the image by means of a calibration strip reserved on the photoplate is also described.

2445 Borgnis, F. *Fundamental electric oscillations of a cylindrical cavity.* Hochfrequenztechnik und elektroakustik, v. 54, no. 4, October, 1939, p. 121–128. 15 p. A theoretic mathematical analysis is made of the electromagnetic resonance of lowest natural frequency in a hollow metal cylinder, filled uniformly with a dielectric, and closed at both ends by a plane surface.

2446 Bouhet, C., and Lemarche, P. *Experimental research on the spreading of the components of castor oil.* France, Ministere de l'air. Publications scientifiques et techniques, no. 51, 1934, p. 1–39. 26 p. Experiments are reported on the spreading of saturated castor-oil films, benzyl benzoate, ricinoleic acid, and mixtures of oleic acid and castor oil in various proportions, on the surface of water. The study includes data on the delay taking place in the establishment of equilibrium of the monomolecular films, which retardation is particularly great in castor oil. Suggestions are made for further chemical and lubrication research, particularly on the interactions and viscosity of oleic acid and castor-oil mixtures.

2447 Verduzic, R. *The parachute.* Rivista aeronautica, v. 14, no. 5 and 6, May and June, 1938, p. 283–303 and 564–596. 35 p. Various phases of parachute jumps are analyzed and conclusions are drawn from experimental parachute work done by Italian pilots. Free falls with unopened parachutes from various heights, horizontal velocity in falls from moving aircraft, the emergence of the pilot parachute from the packing envelope and its unfolding, stresses of the pilot parachute on the main parachute, unfolding of the main parachute, stresses on the suspending ropes, and the descent with the fully opened parachute are studied.

2449 Dyatschenke, and Selegenev, V. *The fading of the ultraviolet phosphorescence of subtractively colored crystals of rock salt.* Journal of experimental and theoretical physics, U.S.S.R., v. 11, no. 5, 1941, p. 530–535. 6 p. An investigation is reported on the fading of the ultraviolet phosphorescence of crystals of sodium chloride irradiated by X-rays and ultraviolet rays, and the excitation spectrum of the ultraviolet fluorescence of these crystals.



A Ship of War—With a Peacetime Destiny

You won't have to beat this weapon of war into a peacetime plowshare. V-J Day will see the Fairchild-designed "Packet" ready to plow the airlanes of commerce.

Built specifically for military cargo—tons of guns, men and equipment for battle—the "Packet's" huge hold will receive the bulky goods of peacetime commerce with ease, speed them hundreds or thousands of miles to their destinations.

Designated by the Army as the C-82, the "Packet" has been nicknamed the "flying boxcar." Its cargo compartment (2,870 cubic feet of unobstructed and continuous space) carries 93% of the capacity of a railroad boxcar.

Facility in loading is a triumph of Fairchild design. Split doors at the rear of the fuselage open to the full width of the cargo space. Cargoes roll smoothly into the "Packet" from a truck, for the "Packet's" horizontal floor is at standard truck floor height. Smaller pieces can be loaded through a forward loading door.

The value of the "Packet," to shippers of all types of "flyable" cargo, will be as broad as the future of air cargo itself. Time and experience will attest to its economy and multiplicity of uses. Thus, the "Packet," now at war, emphasizes the Fairchild tradition of advanced aviation, "the touch of tomorrow in the planes of today."

BUY U. S. WAR BONDS AND STAMPS

Fairchild Aircraft

Division of Fairchild Engine & Airplane Corporation, Hagerstown, Maryland

2450 Rummel, H., Esmarch, W., and Benther, K. *Degassing of aluminum by means of sound and supersonics.* Metallwirtschaft, v. 19, no. 46, 1940, p. 1030–1033. 6 p. Experiments were successfully carried out on the degassing of aluminium by the use of sound waves. The direction of sound waves into the melt from the outside presented difficulties in the degassing of large quantities of metal. The time required for degassing was less when the vibrations were produced inside the melt, by action between an alternating current of sound frequency and a static magnetic field.

2451 Colombi, C. *New curves of heat-energy transformation. The enthalpy-thermodynamic potential diagram and its applications.* Bulletin technique de la Suisse romande, v. 66, no. 16, August 10, 1940, p. 169–174. 8 p. The author takes up the representation, by means of enthalpy-thermodynamic potential diagrams, of transformations during which mechanical energy is converted into heat and which are followed by cooling at constant pressure, in the case of a fluid traveling along a mobile duct or in the diffuser of a turbocompressor unit. The representation is also discussed of transformations during which mechanical work is converted into heat while the compressed fluid is constantly brought back to its initial temperature by continuous cooling.

2454 Germany. Luftwaffe. *Regulations for altitude flying and instructions on the use of respirators.* Berlin, 1941. 38 p. The causes, symptoms, and effects of altitude sickness are described, and procedure to be followed by the pilot in maintaining efficiency, in preventing altitude sickness, and in relieving its symptoms after onset are outlined. Illustrated descriptions, installation, operating and testing instructions for inhalation equipment are given, with particular reference to nonfreezing respirator 10-67 (HM51), interceptor aircraft mask 10-86, and fighter respirator 10-69. Sections on the use of respirators during incidents and accidents in altitude flight, and descriptions of special clothing to be worn on such flights, are included.

2455 *The "S.O. 30N" and its design features.* Aviation française, no. 7, March 21, 1945. 3 p. The aerodynamic characteristics, structural design, and installation of auxiliary equipment of this prototype transport airplane are briefly described. It is a twin-engined all-metal airplane of the midwing type. The chief features of its design are said to be the evolved profile of the airfoil section of the wing and the setting of the engine nacelles and the fuselage in such a way that the lift distribution differs but slightly from an elliptic distribution. It has a cargo space of 26.5 cu.m. which can be increased by 17.5 cu.m. by using a rack for the release of mail sacks by parachute. As a military transport, it can accommodate up to 44 fully equipped men, or 12 stretcher cases, or 14 sitting cases. An illustration shows the arrangement of instruments and controls in the pilots' compartment.

2457 Schmitz, F. W. *Aerodynamics of aircraft models. Chapter 1, Aerofoil measurements, Parts 5–7.* 1942. 49 p. On the basis of measurements of model airfoils, it is concluded that the polars of the measured profiles make it possible for the first time to deal mathematically with the performance and stability of flying models in the Reynolds Number range of 20,000 to 170,000. New bases are given for the assessment of experiments in the free-flight wind tunnel. The results may also be applied in designing small blowers and centrifugal pumps and fans.

2458 Noack, W. G. *The present day status of the Velox boiler.* Zeitschrift des Vereines deutscher ingenieure, v. 85, no. 51–52, December 27, 1941. 14 p. The heating surfaces, evaporating element, superheater, feedwater heater, blower set, wear in the gas turbine, deposits in the axial compressor, circulating pump, features on the water side and the gas side, and the design and operation of Velox boilers for use both on land and at sea are discussed.

2459 Schrader, A. *Structure investigations in aluminium metallurgy.* Aluminium, v. 25, no. 3, March, 1943, p. 116–126. 16 p. The author surveys structural investigations of aluminum alloys as a way of showing, as no other method of examination can do, what is really happening in the alloy. The importance of the method as a scientific basis for production and further treatment of aluminum is stated.

2460 Schmitz, F. W. *Aerodynamics of aircraft models. Chapter 1, Aerofoil measurements, Parts 1–2.* 1942. 42 p. Wind-tunnel airfoil measurements were carried out in a Reynolds Number range of 21,000 to 168,000 on various airfoils for the purpose of obtaining, for the flying model, guidance in the selection of the profile with respect to the parameters, guidance for the selection of the wing outline, and guidance for the selection of the blade profile and blade outline for the airscrew of the model. The observation of bird flight is recommended on the basis of the results, as the bird and the model aircraft fly in the same Reynolds Number range. As analogy to the classic experiment with the sphere, devices for producing artificial turbulence through wall roughness, turbulence edges, or frontal wires have a favorable effect on the aircraft model as opposed to the detrimental effect on full-scale aircraft. The air jet of the wind tunnel used was largely nonturbulent.

2462 Jaumann, A. *Coupling circuits for H.F. amplifiers.* Hochfrequenztechnik, v. 62, no. 4, October, 1943, p. 111–112. 25 p. According to the use to which the amplifier is to be put, differentiation is made between three cases: smoothing of the amplification curve; smoothing of the transit time curve; and smoothing of amplification- and transit-time curve. By means of a frequency transformation it is possible to reduce the designing of an amplifier for any given frequency band to that of an aperiodic amplifier. Both the two-terminal and the four-terminal coupling network are dealt with mathematically for the three cases referred to, and the important results of the calculation are shown in curve tables that are intended for practical use.

2463 Hoffmann, E. G. *The effect of the exponential distribution of current on the diagram of the rhombic antenna.* Hochfrequenztechnik, v. 62, no. 1, July, 1943, p. 15–20. 9 p. By the assumption of exponentially damped distribution of current along the rhombic antenna, the radiation diagram remains essentially unchanged compared with that obtained for undamped progressive current. For constant input current the damping becomes noticeable in a reduction of the amplitude of the field strength and results in the zero points occurring for undamped distribution of current being transformed into radiation minima. The radiation minima are, for the same damping, much greater in relation to the radiation maxima in the case of the simple long-wire antenna in the form of a straight wire.

2465 Dirksen, B. *On the development of play in bolted joints under fatigue.* Luftfahrtforschung, v. 19, no. 4, May 6, 1942, p. 153–156. 7 p. The time variation of the lateral pressure on the bolt-hole during the whole period of the fatigue test was continuously recorded for a small number of bolted joints. Unidirectional fluctuating tensile or compression stresses gave consistent results, but for the alternating stresses an additional damped oscillation was noted, excited by every change of direction of the stress. Comparative measurements of enlargement taking place during the fatigue tests show a fundamental relationship between the increase of enlargement and the periodic development of the stresses in the bolt. The hitherto available series of tests are not considered conclusive.

2466 Saint-Arnaud, A. *The S.O. 30N. A very special prototype.* Aviation française, no. 5, March 7, 1945. 2 p. (Abstract of original article) The S.O. 30N, designed in 1941 and completed in 1943, was originally intended for passenger flights of 1,200 miles, with 23 passengers and 4 crew members to be accommodated in a 3-compartment fuselage. This airplane is obsolete and it is unlikely that it will go into production, but information gained from flight tests will be applicable to the new S.O. 30R, scheduled to come off the production line early in 1946. Some specifications and performance data are given.

More than a dozen points of attachment are provided by this Alcoa Aluminum forging. Its use avoids high labor costs and manufacturing hazards, entailed in building up a part for the same task. A maximum saving in weight is achieved.

All of the usual advantages gained with Alcoa Aluminum are retained—strength, lightness, corrosion resistance and dependability.

Intricate parts, surprisingly large in size, are possible in Alcoa Aluminum forgings. Alcoa engineers, skilled in their design and production, will gladly assist in adapting aluminum forgings to your products. ALUMINUM COMPANY OF AMERICA, 2142 Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA FIRST IN ALUMINUM

ALCOA ALUMINUM

2467 Eweis, M. *Friction and leakage losses in piston rings.* Forschung auf dem gebiete des ingenieurwesens, v. 6, no. 2, p. 104. (Abstract from Forschungsheft, p. 371) 2 p. Using an arrangement in which the piston was held rigid by the measuring apparatus and the cylinder allowed to move, experiments were made on friction and leakage characteristics of piston rings. Piston friction was measured in particular for gas pressure remaining constant or changing with time for operating temperatures up to 120°C., taking oil influence into account. Because of the low maximum piston speed of two meters per sec., only half the region of fluid friction was covered.

2468 Hohenemser, K., and Prager, W. *The mechanics of the plastic deformation of mild steel.* Zeitschrift für angewandte mathematik und mechanik, v. 12, no. 1, February, 1932, p. 1–14. 17 p. The author deals first with a systematic development of the mechanics of the plastic behavior of metals on the assumption that the latter may be regarded as quasi-isotropic. Experimental results are given, some of which agree and some vary with the earlier theorems of the mechanics of plasticity. These results conform better with a new, more general theorem that includes the earlier results as special cases, but indicate that a complete description of the plastic behavior of steel on the basis of the mechanics of isotropic continua does not seem possible.

2469 Becker, W. *Oblique incidence of plane electromagnetic waves on the ionosphere.* Hochfrequenztechnik, v. 62, no. 5, November, 1943, p. 137–148. 17 p. The author deals with the influence of a plane ionized layer, in which the density of electrons has a maximum at the center and decreases steadily to zero in both directions from the center, on the radiation from a horizontal antenna. The approximately spherical wave radiated from the antenna is replaced by plane waves meeting the ionosphere at various angles of incidence. Special attention is paid to optimum reception, or in what position the transmitted signal is received with minimum distortion and maximum strength. The apparent path length of signals is calculated. The reflection and transmission coefficients of the ionosphere are calculated for plane electromagnetic waves at arbitrary angles of incidence.

2470 Zeman, J. *The recent development of two-stroke engines. Part 1, Charging methods and arrangements.* Zeitschrift des Vereines deutscher ingenieure, v. 87, no. 1-2, January 9, 1943, p. 7–14. 12 p. The requirements, methods, and measurement methods of scavenging, possibilities of uniflow scavenging, requirements and design possibilities of loop scavenging, supercharging, and various types of scavenging pumps are surveyed.

2471 Lubeck, H. *The principles of the magnetophone method.* A.E.G. mitteilungen, no. 9, September, 1938, p. 453–459. 11 p. The Allgemeine Electrizitats Gesellschaft in collaboration with I.G. Farben-Industrie has developed a magnetic tape recorder, which employs a tape consisting of a ferromagnetic layer of powder molded onto a nonmagnetic flexible base. The magnetizing head is of ring shape and provided with a gap at the point of contact with the film. The author discusses recording and wiping with ring heads, magnetizing phenomena in the films, and recording with ring heads. It is concluded that the quality of sound obtained by the magnetophone method is equal to that of other high-grade sound recording methods, and that it offers advantages in simple and reliable operation by untrained operators, cutting capacity, possibility of reproduction as often as required, listening facilities during recording, immunity from vibration, light weight, facility of correcting a faulty recording, and re-use of the tape.

2472 Schleicher, F. *Buckling stresses on rectangular fixed plates.* Mitteilungen forschungs hütte, Gutehoffnungshütte Konzern, v. 1, 1931, p. 186–192. 14 p. The conditions in which flat plates of uniform thickness tend to buckle when stressed by forces acting in the same plane, were examined for various cases of rectangular and circular plates. The author shows the conditions for buckling and the numerical calculation of buckling stresses for a further case of a rectangular plate, in which the validity of Hooke's law is assumed.

2474 Scherle, E. *Examples of the use of copper-coated aluminium sheet from the aspect of material properties.* Metallwirtschaft, v. 19, no. 14–15, April 10, 1940. 4 p. The uses, nature of surface, heat conductivity, chemical behavior, soldering properties, electrical conducting properties, and physical properties of copper-coated aluminum sheet are surveyed.

2477 Meyer, W., and Berg, H. *Uranium dioxide as a material for electrical resistances.* Techwiss A.C.K. Osram-konzern, no. 3. 3 p. The advantages of uranium dioxide as an electrical resistance material with a high negative temperature coefficient of resistivity are surveyed.

2478 Hohenemser, K. *Flow tests on steel tubes under combined tension and torsion.* Zeitschrift für angewandte mathematik und mechanik, v. 11, no. 1, February, 1931, p. 15–19. 6 p. The tests conducted showed a satisfactory confirmation of the work of Hencky, which uses the condition of flow expressed by a single equation in the stress components. The Reuss theory of plasticity, adding R. von Mises' fundamental equations to the elastic fundamental equations differentiated with respect to time, is contradicted by these tests. Besides the flow with constant stress in metals, there are also states in which the stresses move at the yield point and yet a unique relation between stresses and strains exists.

2480 Stablein, W. *Measurement of the characteristics of frequency-modulated oscillations.* Elektrische nachrichten-technik, v. 4, no. 20, April, 1943, p. 102–111. 12 p. A brief summary is given of the characteristics of frequency-modulated oscillations and the representation of the frequencies of the frequency spectrum with the aid of Bessel functions and a pendulum vector diagram. A method is described in which an oscillation of constant frequency and the same amplitude is superimposed on the frequency-modulated oscillation. The figures of the resultant beats are formed on the oscillograph and from them are determined: the magnitude of the modulation index or the phase deviation, leading to the frequency deviation for a given modulation frequency; the form of the modulation curve; and the curve and phase relation with respect to the frequency modulation where amplitude modulation also occurs.

2481 Heuvelink, H. *The testing of graduations of theodolites and universal instruments.* Zeitschrift für instrumentenkunde, v. 45, no. 2, February, 1925, p. 70–84. 14 p. Observations with theodolites and other graduated instruments were made under identical conditions, to determine the relative value of graduated circles of different diameters according to the size of the instrument concerned. The observation error increases with increasing diameter of the circle, but only slowly in passing from a 35-cm. to a 21-cm. diameter. The author questions the advantage, in practical geodetic surveying, of using graduated circles with diameters of 27 cm. or 35 cm. Practically, the same degree of accuracy can be obtained with the handier 21-cm. or even 18-cm. circles.

2482 Vetterlein, P. *Sound frequency spectrograph with inertia-free commutator.* Zeitschrift für technische physik, no. 1, 1942, p. 17–24. 11 p. Using a sound frequency spectrum, a new circuit arrangement is discussed which avoids the use of a rotary switch and effects the switching operations by means of electron valves. As a basis for this modification the saturation characteristic of a valve, which is to be modulated, was found. The circuit connections are given. The experimental construction of a spectrometer is described and examples of partial sound spectra taken by the new apparatus are shown.

2484 Pungel, W., and others. *Influence of thickness on the properties of wire ropes.* Zeitschrift des Vereines deutscher ingenieure, v. 87, no. 31-32, August 7, 1943, p. 493–497. 8 p. Rupture tests were made on loops of wire ropes of 6.3- to 18.9-mm. diameter, passed over rollers of 50- to 200-mm. diameter. The minimum roller diameter required for

International News Photo.

Below—Cutaway view of high pressure marine boiler typical of those used on many naval and merchant ships. Tubes are mechanically rolled and expanded into headers to provide a dependable pressure joint.

Photo courtesy Combustion Engineering Co., Inc.

SEAGOING STRENGTH in FEDDERS Aluminum Oil Coolers for Aircraft

THERE can be no compromise with reliability in boilers generating the power to move Uncle Sam's naval and merchant ships. Ruggedness is equally important in vital equipment on Uncle Sam's battle planes.

Fedders uses the same proven principle of tube and header assembly in aluminum oil coolers for aircraft as is used in high pressure boilers.

Mechanically bonded joints of unequalled strength are obtained by spinning and expanding tubes into the header plates. This operation is performed at normal room temperature. There can be no chemical or metallurgical change due to high heat.

Double wall thickness and strength are provided at every joint.

In addition to extreme strength, tubes are readily replaced if damaged in service. Fedders construction eliminates necessity for plugging leaky tubes and consequent loss in performance. Tubes can be replaced in a few minutes, and face leaks repaired in a few seconds.

Fedders aluminum oil coolers have logged thousands of flying hours under all conditions of temperature and altitude.

Write for data on application of coolers to specific installational requirements.

fedders

FEDDERS MANUFACTURING COMPANY, INC.

BUFFALO 7, N. Y.

HEAT TRANSFER SPECIALISTS SINCE 1896

ropes in order to maintain the tensile strength equivalent to that of straight rope without the bending stress caused by passing over the roller, was determined. For simple loops, the roller diameter should be at least 18 times the diameter of the rope; and for crossed loops, at least 21 times. The load amplitude at minimum load for wire ropes of 90 kg./mm.^{2} tensile strength was 25 to 30 per cent of the ultimate strength, and for ropes of 170 kg./mm.^{2} it was 15 to 20 per cent. With increasing mean stress value, the supportable stress amplitude decreases. Under high mean stress, the supportable amplitude increases, particularly for hard-wire ropes, while for soft-wire ropes the reverse is the case.

2487 Hartz, H. *Vibration theory of machinery foundations.* Berlin, Genest, 1937. P. 26–32, 43–53. 11 p. The analysis of active suppression of periodically induced disturbances in designing foundations for engines of various cylinder arrangements, and the analysis of active suppression of shock disturbances, are given.

2492 Deuker, E. A. *On the stability of elastic shells. Part 1.* Zeitschrift für angewandte mathematik und mechanik, v. 23, no. 2, April, 1943, p. 81–100. 26 p. The investigations of finite deformations of a continuum and the criteria of stability of the elastic equilibrium to be derived from the results are applied to thin elastic shells. The fundamental equations of the theory of shells for finite deformations are first developed as a necessary basis for investigations of stability. It is claimed that the application of the methods and results of differential geometry, in particular the consequent application of the tensor calculus, makes it possible to develop clear general formulas and facilitates the treatment of special problems. The example of the circular cylindric shell is illustrated.

2493 Deuker, E. *On the stability of elastic shells. Part 2.* Zeitschrift für angewandte mathematik und mechanik, v. 23, no. 3, June, 1943, p. 169–179. 13 p. The formulas derived previously are applied in dealing with the stability of the closed spherical shell under uniform external pressure. The author advances three reasons why his analytic treatment of the problem is simplified: a particular characteristic of the sphere, such as the proportionality of its curvature tensor to its dimension tensor; the symmetry of the fundamental solution; and the absence of boundary conditions, which are to be replaced by the requirement that the solutions remain regular over the whole sphere.

2494 Pischinger, A. *Oscillations in gas columns, with special reference to induction and scavenging processes in 2-stroke engines.* Forschung auf dem gebiete des ingenieurwesens, v. 6, no. 6, November-December, 1935, p. 273–280. 12 p. A process is described for the analysis of the gaseous flow in a system of pipes and receivers, with particular reference to the two-stroke scavenging system. The tests show that the effect of friction against the pipe walls is negligible. The damping in the silencer is similar to that in a diaphragm. There is a difference in the effect of diaphragm and silencer with a high number of revolutions after the preliminary exhaust. In several examples, the reliability of the method of calculation was established by comparing results obtained by calculation and by measurement. The influence of exhaust pipe length was examined and the most favorable length defined.

2495 Schmidt, F. R. *The induction and discharge process and limitations of poppet valve operation in a 4-stroke engine.* Luftfahrtforschung, v. 16, no. 5, May 20, 1939, p. 251–275. 44 p. The gas exchange process and its attendant losses, the mean velocity of the gases, examination of spatial limits, maximum r.p.m. attainable, mechanical limits in valve operation, classification and comparison of the attainable r.p.m., and materials and manufacture are surveyed.

2498 Jegorow, G. *Measurement of direction velocity and pressure in a three dimensional current.* Luftfahrtforschung, v. 19, no. 9, October 20, 1942, p. 326–330. 10 p. A means of measurement of flow in space is described, depending on the principle of pressure measurement with spheres arranged free from interference. The determination of the quantities sought follows with the help of constants that are obtained by means of calibration on the basis of the relations between the pressures exhibited at the surface of the sphere and the quantities to be determined. The process is stated to be useful for measuring pressures and velocities in a three-dimensional flow, easily and accurately.

2499 Hiedemann, E. *Physical-chemical effects of supersonic waves.* Archiv für des eisenhüttenwesen, v. 12, no. 4, October, 1938, p. 185–193. 17 p. The production and physical effects of supersonic waves, their physicochemical effects, destruction of states of unstable equilibrium, initiation of chemical reactions, electrochemical and photochemical effects, colloid chemical effects, production of disperse systems, conglomeration and precipitation of smoke and fog, improvement of metallic materials, and the testing of materials are subjects surveyed.

2500 Lutz, O. *Graphical determination of wall temperature during heat transfer.* Forschung auf dem gebiete des ingenieurwesens, v. 6, no. 5, Sept.-Oct. 1935, p. 240–244. 7 p. The author's method of graphic determination of wall temperature during heat transfer through walls of any arbitrary shape is extended to cover the case of axially symmetric bodies and also the frequent cases where the coefficients of heat transmission and exterior temperatures are not constant.

2501 Chwalla, E., and Novak, A. *The theory of one-sided web stiffeners.* Der Stahlbau, supplement to Bautechnik, v. 10, no. 10, May 7, 1937, p. 73–76. 10 p. An analysis is presented of the case of a steel plate, 1800 by 1500 by 10 mm., subjected to pure shearing forces, and reinforced in its middle by a vertical, one-sided, welded-on flat stiffener, 70 by 10 mm. in size.

2503 Focke-Wulf flugzeugbau g.m.b.h., Bremen. *The Lorin nozzle for aircraft propulsion.* 1944. 40 p. An illustrated review is presented of applications of the Lorin nozzle to aircraft, propellers, and a combination of jet propeller with a rotating wing.

2504 *Ball joints for controls. Technical note on the "H" ball joints, types 41.* 1940. 10 p. (Translation of French publication.) Various models of ball joints are illustrated and described. The advantages claimed for the designs shown are the slight tension on the spring required to lock the relaxing device against the ball, allowing smooth movement of the ball in the socket, and the ease and speed of the unlocking.

2506 Sedov, L. I. *Planing on a water surface.* Tekhnika vozdushnogo flota, U.S.S.R., no. 4-5, 1945. 28 p. Subjects presented are the general conditions of planing on a water surface, fundamental parameters defining the nature of steady planing motion, a new theoretic treatment of planing, methods of defining the hydrodynamic characteristics of planing motion, and the stability of planing motion.

2507 *Piezo-electric microphone of small dimensions.* Zeitschrift des Vereines deutscher ingenieure, v. 87, no. 25-26, June 26, 1943, p. 406. 1 p. A microphone is briefly described, utilizing the high piezoelectric effect of Rochelle salt. Its spherical microphone box has a diameter of 48 mm. and its sensitivity is 1 millivolt/microbar.

2508 Heilbing, F. *Development of the Weibel welding process for aircraft construction.* Junkers-nachrichten, v. 14, no. 7-8, July-August, 1943, p. 53–59. 8 p. The equipment and operation of the Weibel welding process for welding light metal alloys are described.

2509 Nasca, P., Rome. *Parachute with a pull-cord provided with a knot and brought within the crown of the parachute surface.* German patent, no. 713,931. Flugsport, v. 33, no. 26, December 24, 1941, p. 80. 2 p. In the parachute described, the pull cord provided with a knot is so enclosed in the housing of a distortable spring mechanism bound with the shroud lines, that each decrease in the pull in the line below a definite value causes a knob to run through the housing, and by the increase in its length effects an increase on the bearing surface of the parachute.

2511 Busemann, A. *Laval nozzles for uniform supersonic flow.* Zeitschrift des Vereines deutscher ingenieure, v. 84, no. 45, No-

Now—you can get DU PONT "LUCITE"

for all airplane applications

In these war years, the capacity of the plants making Du Pont "Lucite" sheets has been increased tenfold. Now comes the welcome news that transparent "Lucite" today is obtainable for use on civilian airplanes. Increasing quantities are becoming available for approved civilian use.

5th WARTIME PRICE REDUCTION!

Economies from this volume production have brought the price of "Lucite" methyl methacrylate resin down—down—down. In fact, in the medium and greater thicknesses, "Lucite" today costs *less* than cellulose acetate plastic. "Lucite" costs no more to install. In normal use, "Lucite" can be counted on to last the life of the plane.

"LUCITE" BRINGS YOU THESE IMPORTANT ADVANTAGES

Among the reasons why the Army and Navy have specified acrylic enclosures for their planes are these distinctive advantages of "Lucite": crystal-clear transparency, light weight, good tensile and flexural strength, resistance to weathering, ease of fabrication and ease of forming.

Du Pont technicians, thoroughly familiar with the forming, machining and design possibilities of "Lucite," will be glad to aid you in applying "Lucite" to your own requirements.

Buy—and Hold—WAR BONDS

FOR PLASTICS.. CONSULT DU PONT

DU PONT REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING ... THROUGH CHEMISTRY

FREE FACTS BOOK ON "LUCITE"!

Write on your business letterhead to E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Arlington, N. J., or 5801 S. Broadway, Los Angeles 3, Calif. In Canada: Canadian Industries, Ltd., Box 10, Montreal.

vember 9, 1940, p. 857–862. 9 p. The behavior of the supersonic flow in a Laval nozzle gives rise usually to a jet with a ruffled velocity distribution in the expanded part of the nozzle. By applying special measures in the shaping of the nozzle, for which a definite minimum length is required, it is possible to obtain for the supersonic flow a velocity distribution of such smoothness that it can be used for high-speed channels. The various decisive aspects of the question are viewed. Reference is made also to the nozzle with mouth cut off obliquely and the production of compression shocks.

2512 Penner, D. I. *Styctographic coherers. Part 1, Oxidation of filings.* Zhurnal teknicheskoi fiziki, U.S.S.R., v. 7, no. 93, 1937, p. 2227–2230. 4 p. For the fixation of the trace of the passage of electrical waves through paper impregnated with chemical agents, a number of coherers are arranged on the paper. The coherers are glass tubes closed at both ends and filled to a certain height with fine oxidized brass filings. A direct current applied to the paper passes through the coherers, causing colored stains to appear under the heads of the coherer plugs by electrolysis. Experiments to determine the best method of preparing the coherers showed that filings oxidized at 170 to 200°C., in a coherer of 12 to 14 mm. in length, and in a layer about 3 mm. long and one-third to one-half of the inner diameter of the tube thick, gave the best results.

2513 Knobloch, H. *On the interpolation of families of curves.* Zeitschrift für angewandte mathematik und mechanik, v. 22, no. 6, December, 1942, p. 364–366. 5 p. On the basis of known work using affine transformations between the function plane and an interpolation plane, the author discusses the efficiency of such transformations. It is stated that a not necessarily affine method frequently yields more favorable results.

2514 Egger, H. *Practical interpolation.* Zeitschrift für angewandte mathematik und mechanik, v. 22, no. 6, December, 1942, p. 362–364. 5 p. A method is given for the direct calculation of the most frequently occurring elementary functions, with the aid of mathematical tables, for use in practical calculation.

2515 Rehbock, F. *The convergence of the Newton method for systems of equations.* Zeitschrift für angewandte mathematik und mechanik, v. 22, no. 6, December, 1942, p. 361–362. 4 p. Theorems and error assessments from an unpublished dissertation of Karl Bussmann are presented, through which certain theorems of A. Ostrowski and Fr. A. Willers become essentially generalized.

2516 *German de-icing technique. Reports on development, devices, etc.* Göttingen, 1944. 8 p. The general principles of deicing of jet propellers, development and present position of electrical deicing methods, and the present position of German deicing research on windshields, pressure heads, directional aerials, jet propulsion units, reciprocating engines, propellers, and wings are discussed.

2517 Fischer, H. *The role of inhibitors in the electrolytic precipitation of metals. Part 2.* Kolloid-zeitschrift, v. 106, no. 1, January, 1944, p. 50–62. 16 p. The secondary effects of high-molecular inhibitors with relatively high occupation density are reviewed on the basis of reported work by various authors.

2518 Zeerleder, A. von. *Testing of aluminium castings.* Die Giesserei, January 9, 1942, p. 7–10. 6 p. The influence of manufacturing processes, such as forging and casting, on the strength characteristics of aluminum parts is discussed. It is stated that the separately cast test bar is preferable to the cast-on test bar because of its simpler and more reliable manufacture. The separately cast test bar in general gives adequate information on the quality of the metals to be used in casting.

2519 Poschl, T. *On the increase of stress in a plate with circular holes and under tension.* 5 p. A theoretic analysis is made of the increase of stress in a plate with circular holes under tension. The results compare qualitatively with results of tests on a disc pierced with two holes and stressed in one direction.

2521 Gossinger, J. *Production of high frequency and high ohm resistances by means of cathode spraying.* Annalen der physik, v. 39, no. 5, 1941. 9 p. Investigations are reported on the course of the temperature coefficient of thin layers of metal produced by cathode spraying, and tested under the Bunsen flame, in the furnace, and in the current heat.

2523 Roos, H. *New equipment of the Junkers research station.* Luftfahrtforschung, v. 13, no. 2, February 20, 1936, p. 67–70. 7 p. A testing table for fracture tests of large structural airplane parts, a large fatigue-test machine for girders, tails, engine mountings, and tail units, and a self-regulating centrifugal unbalance for vibration testing are described.

Changes of Address

To facilitate the prompt receipt of copies of the JOURNAL and REVIEW, members and subscribers are requested to give the editorial offices 30 days' notice of any change of address.

Notices should be sent directly to the Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N.Y.

Bubble Sextant Readings

(*Continued from page 35*)

Hence, the total vertical acceleration is given by

$$2\omega v \sin\theta \cos l + (v^2/r)$$

The angular error in the bubble sextant for bearings at right angles to the track is therefore

$$(57.2958)(60) \times \left[\frac{2\omega v \sin l + (v^2/r)\sin\theta\tan l}{g_0 - (v^2/r) - 2\omega v \sin\theta\cos l}\right]$$

minutes of arc

where g_0 is the local acceleration due to gravity, given by Helmert's formula as

$$g_0 = 0.03281 \times (980.616 - 2.5928\cos 2l + 0.0069\cos^2 2l)$$

l	g_0	l	g_0
0	32.088	60°	32.215
10°	32.093	70°	32.238
20°	32.107	75°	32.246
30°	32.130	80°	32.252
40°	32.158	85°	32.258
50°	32.187		

Example

Consider, as an example, an aircraft speed of 400 m.p.h. (v = 586.6 ft. per sec.). Taking r as 20,920,614 ft., the angular error in the bubble sextant, when taking a sight on the beam, is given in Table 1 for various values of θ, the course, and l, the latitude.

THE BIRD WITH THE 16-MILE TAIL

The wire you see with the parachute on the end of it is a telephone wire, being payed out from a C-47 cargo plane.

Bell Telephone Laboratories, working with the Air Technical Service Command of the Army Air Forces, developed this idea. It will save precious lives and time on the battlefield.

A soldier throws out a parachute with the wire and a weight attached. The weight drops the line to the target area. From then on, through a tube thrust out the doorway of the plane, the wire thrums out steadily — sixteen miles of it can be laid in 6 2/3 minutes. Isolated patrols can be linked quickly with headquarters. Jungles and mountain ranges no longer need be obstacles to communication.

This is in sharp contrast to the old, dangerous way. The laying of wire through swamps and over mountains often meant the transporting of coils on the backs of men crawling through jungle vegetation, and in the line of sniper fire. It is reported that in one sector of the Asiatic theater alone, 41 men were killed or wounded in a single wire-laying mission.

Bell Telephone Laboratories is handling more than 1200 development projects for the Army and the Navy. When the war is over, the Laboratories goes back to its regular job — helping the Bell System bring you the finest telephone service in the world.

BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting for the Armed Forces at war and for continued improvements and economies in telephone service.

The Standard Guide to Private Planes

Edited by Lester Ott

Contents: How to Buy an Airplane; Personal Aircraft; Rotary Wing Aircraft; Gliders and Sailplanes; Aircraft Engines; Aviation Insurance and Financing; Private Plane Specification Chart; How to Obtain a Pilot's License; Flying Regulations; Instrument Flying; Navigation—How to Fly Cross Country; Weather for the Private Pilot; Airport Guide; Where to Learn to Fly; Aircraft Dealers and Distributors; How to Fly a Plane; Classified Directory.

Landplanes, rotating wing aircraft, amphibians and sailplanes for the private owner are described in this guide. Excellent illustrations and informative text give the prospective buyer a broad idea of the present types offered.

The text, written in nontechnical language, explains the fundamentals of flight and discusses the advantages of different aircraft types and control devices. Individual models are listed according to manufacturer's name and type designation, and specifications are tabulated.

In addition, there is much useful information about engines, financing, insurance, flying instruction, licenses, and regulations. George W. Stewart, New York, 1945; 128 pages, $2.00.

Your Personal Plane

John Paul Andrews

Contents: Strictly Personal; Future Perfect; Who Wants Wings?; What—And How Much?; Safer Than Crossing the Street; Flights of Fancy; Fifty Ways to Fly; The Fool-proof Plane; The Low-priced Plane; The Deluxe Planes; The Special Types; Heaven Has No Whistle Stops; Of Plans and Planes; Tax Dollars and Common Sense; Tomorrow's Vacation; Personal Planes for Personal Gain; The Way to Go Home; Directory of Small Airports.

For those who are contemplating the purchase of a private plane this book will be helpful. It presents facts and figures about the costs of operation and upkeep of a plane for personal use. Safety as a prime element of sales appeal is stressed. The possibilities of pleasure trips are noted and many vacation routes to holiday locations are given.

Descriptions of many of the private planes now or soon to be offered on the market are listed, so that prospective owners may make comparisons. The need for more airports for the use of the owners of private planes is shown and a system of air markings is described.

The book is also a guide for civic-minded men who are wisely planning to obtain for their communities a strong position in the network of air travel of the future. Duell, Sloan & Pearce, New York, 1945; 230 pages, $2.50.

With the exception of aeronautical annuals and books published outside the United States, books reviewed in this section may be borrowed without charge from The Paul Kollsman Library of the Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N. Y.

Science in Progress

Edited by George A. Baitsell

Contents: Psychological Aspects of Military Aviation, by Walter R. Miles; The Physical Structure and Biological Action of Nerve Cells, by Detlev W. Bronk; Energy and Vision, by Selig Hecht; Chemical Transmission of Nerve Impulses, by Otto Loewi; The Mathematical Nature of Physical Theories, by George D. Birkhoff; The Magnetic Approach to the Absolute Zero of Temperature, by Peter Debye; The Drift Toward Equilibrium, by Henry Eyring; Streams of Atoms, by Isidore I. Rabi; Adventures in Vacuum Chemistry, by K. C. D. Hickman; Present Status of the Vitamin B Complex, by C. A. Elvehjem; Blood and Blood Derivatives, by Edwin J. Cohn.

In this fourth of a series of volumes, Dr. Walter R. Miles, of Yale University, has a chapter "Psychological Aspects of Military Aviation." He outlines the tests used in the selection of flying personnel for the Army and Navy, and gives some of the results obtained from these studies in the elimination of trainees by aptitude tests.

The equipment used for making these tests is described. After a cadet is accepted and trained there are other psychologic observations required to keep a pilot fit for high-altitude and combat operations. All of the tests for maintaining operational efficiency in airmen are referred to in the paper.

The synchronizing of man's psychologic skills with the products of the mechanical and technical laboratories and factories is the ultimate objective of work in the field of aviation medicine. Yale University Press, New Haven, Conn., 1945; 331 pages, $3.00.

Scientific Societies in the United States

Ralph S. Bates

Contents: Scientific Societies in Eighteenth Century America; National Growth, 1800–1865; The Triumph of Specialization, 1866–1918; American Scientific Societies and World Science, 1919–1944; The Increase and Diffusion of Knowledge.

The history of scientific organizations in Europe and the United States is traced from their beginnings, the earliest in this country being The American Philosophical Society, founded by Benjamin Franklin in 1743. During the next 150 years many general scientific societies and associations were organized. After the Civil War the era of specialization began and, with it, the founding of societies with limited fields of interest. The book comments on several aeronautical groups, including the Institute of the Aeronautical Sciences. The book concludes with the following observation:

"The scientific societies are among the foremost agencies for advancing scientific research. The great national scientific societies and councils bring together scientific workers from all parts of the nation, and, made up as they are of men from the universities, the professions, research institutions, government bureaus, industrial laboratories, and from the scientifically inclined among the public at large, they afford the best means of coordinating every facility for research throughout the nation. . . . Not only have the scientific societies—national, state, and local—been the means of stimulating the esoteric devotees of science, but through their museums, libraries, and open meetings they have exerted a wide educational influence upon the general public. The study of the history of American science involves not only discoveries and the men who made them, but also an appreciation of the role played by associations of scientists in stimulating research and in affording the opportunities and media for publicizing and conveying the achievements of science." John Wiley & Sons, Inc., New York, 1945; 246 pages, $3.50.

Structural Theory and Stress Analysis
for Aircraft Designers and Draftsmen

BASIC STRUCTURES

By F. R. Shanley

Chief Structures Engineer, Lockheed Aircraft Corp.

Specifically prepared to meet the needs of designers, draftsmen, and stress analysts, BASIC STRUCTURES clearly explains structural analysis by emphasizing the physical action involved. It eliminates formal mathematical treatments. Easily understood, thoroughly detailed, carefully organized. An invaluable addition to your ready-reference library. Note some typical subjects covered:

- Analysis of curved members forming part of a truss.
- Analysis of a landing gear tripod by analytical and graphical methods.
- Strength and deflection of "tension-field" shear webs.
- Shear flow in curved webs.
- Relative torsional strength and deflection of square and round tubes.
- Relative bending efficiency of various cross-sectional shapes.
- Modulus of rupture of round tubes in torsion and bending.
- Analysis of box-beam wing structure under unsymmetrical bending.
- Crushing forces due to curvature or dihedral angle.

(1944) 392 Pages $4.50

JOHN WILEY & SONS, INC.
440 Fourth Ave., New York 16, N.Y.

JOHN WILEY & SONS, INC.
440 Fourth Ave., New York 16, N. Y.

Please send me Shanley's BASIC STRUCTURES on ten days' approval. At the end of that time, if I decide to keep the book, I will remit $4.50 plus postage; otherwise I will return the book postpaid.

Name.....
Address.....
City and State.....
Employed by.....AER-9-45

Prospects and Problems in Aviation

Contents: Growth of the Aircraft Industry, by G. M. Williams; Growth of Air Transport, by L. C. Sorrell; Prospective Expansion of Airline Routes and Services in the United States, by W. A. Patterson; An Adequate Air Transport System for the United States, by Arthur E. Raymond; Prospective Passenger Traffic, Volume, Rates, and Service, by L. C. Sorrell; Prospective Cargo Traffic, Volume, Rates, and Service, by L. C. Sorrell; Transport Aircraft of the Future, by William Littlewood; Future of the Aircraft Industry, by E. E. Wilson; Airport Location, Design, and Financing, by John Groves; Freedom of the Air and the Community Company in International Air Transport, by Col. J. Carroll Cone; Regulated Competition in International Air Transport, by Ralph S. Damon; Regulation of Air Transports, State, Federal, Local, Including Taxation Problems, by S. G. Tipton; Tax Policy for Commercial Aviation, by George W. Mitchell; Control and Operation of Air Transport in Relation to Other Forms of Transportation, by Kenneth F. Burgess.

One of the best summaries of the present and future status of aviation in this country was given by twelve speakers at the Chicago Forum organized by the University of Chicago and the Chicago Association of Commerce. Those presenting papers were carefully chosen specialists in their particular fields. As a result, the proceedings are exceptionally informative.

Each speaker treated the subject assigned to him with great breadth of view, and some presented statistical facts that will be helpful to a better understanding of the problems of the aircraft-manufacturing and air-transport industries. The Chicago Association of Commerce, Chicago, 1945; 212 pages, $2.00.

American Air Navigator

Charles Mattingly

Contents: Earth and Charts; Instruments; Dead Reckoning; Radio Navigation; Celestial Sphere; Air Almanac; Time; Aircraft Octant; Position Lines; Stars and the Weather; Special Procedures; You Navigate to Honolulu.

In writing this text, the author's object has been to separate practical, applicable information about air navigation from the vast field of theory and to present it in compact form. The book is intended for students of air navigation and for those actually engaged in this profession. It contains descriptions and illustrations of methods and principles that have been tested and proved under many conditions and in various parts of the world. Ziff-Davis Publishing Company, New York, 1944; 229 pages, $6.00.

G&O Radiators
30th Year

ENGINE COOLING RADIATORS

•

OIL COOLERS

The G&O Manufacturing Co.
NEW HAVEN, CONNECTICUT

Aircraft Engineering
FOUNDED 1929
The Technical and Scientific Aeronautical Monthly
Edited by
Lt.-Col. W. Lockwood Marsh
F.I.Ae.S., M.S.A.E., F.R.Ae.S.

Single Copies: 50 cents post free
Subscription: $5.25 per annum, post free

During the War, a special feature is being made of reproductions and translations from the Foreign Technical Press

BUNHILL PUBLICATIONS LIMITED
12 Bloomsbury Square
London : : W.C.1.
England

Book Notes

Junior Model Planes, designed and illustrated by James D. Powell, edited by Ed Clarke; Thomas Y. Crowell Company, New York, 1945; 91 pages, $1.50.

Instructions for the beginning model aircrafter are given in this book. It shows the boy who is interested how to build the models, starting with a glider and ending with a complete transport airplane. The illustrations and text are easily understood without diagrams, and the tools and materials needed are of a kind that is usually available.

The authors are experienced in aviation and have produced a book that will give an encouraging stimulus to many boys.

United States Naval Academy: The First Hundred Years, by John Crane and Lt. James F. Kieley; Whittlesey House, New York, 1945; various paging, $5.00.

For the thousands of officers and men serving in the Navy, who were not privileged to attend the Naval Academy at Annapolis, and for others, this history gives the background of the development of naval training and traditions.

Pictorially the book is exceptional. Its fine illustrations feature the history, facilities, and activities of the Academy.

Iowa Jima, by Capt. Raymond Henri; U. S. Camera Publishing Corporation, New York, 1945; 96 pages, $1.75.

Seventy-two days before the Marines landed on Iwo Jima airplanes began pounding the island. For 3 days before the invasion a naval task force bombarded Iwo. To capture this island, only 8 miles square, the 7th Air Force gave it a thorough "presoftening."

The action pictures in this book are some of the most impressive that have come out of the war and will serve as another evidence of the determination and heroism of the Marine Corps. In 36 days, 4,300 Americans lost their lives so that two airfields from which combat airplanes could take off to bomb Japan might be captured.

Poems for a Son with Wings, by Robert P. Tristram Coffin; The Macmillan Company, New York, 1945; 123 pages, $1.75.

The author, a well-known writer of poems, has collected in this book a group of his writings which have grown from the experiences of his son who is a pilot.

The poems are not only about flying but also encompass the family life and New England surroundings of his son.

U.S. Coast Guard Pictorial and Service Log; Books, Inc., New York, 1944; 72 pages, $1.00.

An illustrated pamphlet that is a guide to the services of the Coast Guard. It traces the history of the unit from its establishment in 1790 as the Revenue Cutter Service. The work of the Coast Guard in peacetime is reviewed, as well as its expanded responsibilities in time of war. The varied equipment is described and illustrated, ranging from the large cutters and invasion craft to small motor lifeboats. A short sketch of Coast Guard aviation is included.

Mission Beyond Darkness, by Lt. Comdr. J. Bryan, III, and Philip Reed; Duell, Sloan and Pearce, New York, 1945; 133 pages, $2.00.

A graphic story is told of the attack by the planes of Task Force 58 during the concluding phases of the First Battle of the Philippines on June 19, 1944. Commanded by Vice-Admiral Marc A. Mitscher, the attacking aircraft consisted of torpedo, bombing, and fighter planes of the aircraft carrier "Lexington." They located the Japanese fleet late in the afternoon, bombed enemy aircraft carriers, and shot down enemy planes. When the attacking planes returned to their carrier base Admiral Mitscher made his famous decision to turn on the lights so that the planes could land. Of the 34 planes sent out in Group 16, nine failed to return.

The entire action was a classic example of naval air attack and the personal stories given in this book illustrate the courage and determination of naval pilots under the most adverse conditions.

Introduction to Microwaves, by Simon Ramo; McGraw-Hill Book Company, Inc., New York, 1945; 138 pages, $1.75.

Detailed and precise information about the characteristics of extremely high-frequency electricity is given in this book. The physical pictures and points of view set forth should be of value both to those doing active work in this relatively new branch of engineering and to those who desire merely a better appreciation of microwave phenomena.

Careers in Science, by Philip Pollack; E. P. Dutton & Company, Inc., New York, 1945; 222 pages, $2.75.

Job opportunities in the field of science are set forth in this book. The author begins with a survey of the whole field and a discussion of the qualifications required. He then takes up in turn various broad divisions of scientific endeavor. One chapter on physics deals with careers in meteorology, radio, and aviation.

Supplementary material includes an introduction by H. C. Madsen, Manager of technical employment and training for Westinghouse Electric Corporation; two appendixes, one an article titled "The Outlook for the Physicist in Industry," by Albert W. Hull, Assistant Director of the General Electric Research Laboratory; the other, an article titled "How Can We Develop Inventors?" by Charles F. Kettering, Vice-President and Director of Research for General Motors Corporation. In addition, there are a bibliography and 56 photographs illustrating many phases of scientific work.

Thermodynamic Properties of Air Including Polytropic Functions, by Joseph H. Keenan and Joseph Kaye; John Wiley & Sons, Inc., New York, 1945; 73 pages, $2.25.

The compression of atmospheric air which occurs in a gas turbine can be computed with reasonable convenience. However, the computations of certain other processes, such as the heating of air in a regenerator, or the expansion of air and similar gases from states of high temperature, involve laborious integrations. To reduce the labor involved in making such calculations, the authors have compiled these tables on the thermodynamic properties of air, including polytropic functions.

Partial Differential Equations, Advanced Course (Conformed Mapping of Multiply-connected Domains), by Stefan Bergman; with addition of lecture on Distortion in Conformal Mapping, by D. C. Spencer; Brown University, Providence, R.I., 1941; various paging, $4.00.

Partial Differential Equations, Chapters I–III, by J. D. Tamarkin; Chapters IV–VII, by Willy Feller; Brown University, Providence, R.I., 1941; 268 pages, $4.00.

Geometrical Foundations of Mechanics, by Hilda Geiringer; Brown University, Providence, R.I., 1942; 154 pages, $2.50.

Ordinary Differential Equations in the Real Domain with Emphasis on Geometric Methods, by Witold Hurewicz; Brown University, Providence, R.I., 1943; 129 pages, $2.50.

The Mathematics of Ultra-High Frequencies in Radio, by Leon N. Brillouin; Brown University, Providence, R.I., 1943; 210 pages, $4.00.

Mathematical Theory of Optics, by R. K. Luneberg; supplementary notes by M. Herzberger; Brown University, Providence, R.I., 1944; various paging, $4.00.

Mimeographed notes prepared in loose-leaf form contain reports of the essential contents of lectures delivered during summer and autumn sessions of the school for Advanced Instruction and Research in Mechanics at Brown University in 1941, 1942, 1943, and 1944.

Education for the Air Age; Claremont Graduate School, Claremont, Calif., 1945; various paging, $1.25.

This bulletin is a compilation of some of the discussion papers presented before a group of aviation students during the 1944 summer session of the Claremont Graduate School. The information contained in these papers provides an approach to the problem of education for the air age. A bibliography of reading materials is included.

COLLINS 32RA RADIO TRANSMITTER*

A deservedly popular 50 watter

THE COLLINS 32RA* was introduced in 1939 as a quality designed, quality built radio communication transmitter, broadly adapted to most applications within its power and frequency scope.

It, or its d-c version—the 32RB†—was immediately put into service by airlines for control towers, by oil pipelines for emergency systems, by fishing companies for fleet control, and by other widely different types of industrial users.

It was found to be rugged, simple to operate, easy to service, and so thoroughly and universally satisfactory that a rising commercial demand was halted only by the war. During the entire war the Armed Forces have employed thousands of these transmitters. A typical use has been that of control towers on air training fields throughout the country.

Of the several up-to-the-minute transmitters which Collins has ready for its civilian customers as Government requirements are cut back, this one represents a type of which limited quantities are now being manufactured for essential civilian uses. If you would like specifications and design data, write us for new, illustrated bulletin. Collins Radio Company, Cedar Rapids, Iowa; 11 West 42nd Street, New York 18, N. Y.

ARMY E NAVY

*COLLINS 32RA—Power source: 115 *volts alternating current*. Power output, 50 watts phone; 75 watts CW. Frequency range, 1.5 to 15 mc. Four frequencies instantly selected by panel control.

†COLLINS 32RB—Power source: 12, 24, 32 or 110 volts *direct current*. Dynamotor, self contained. Otherwise identical with 32RA.

IN RADIO COMMUNICATIONS, IT'S . . .

COLLINS

Report on the Measurement of Surface Finish by Stylus Methods, by R. E. Reason, M. R. Hopkins, and R. I. Garrod; Taylor-Hobson Research Department, Taylor, Taylor & Hobson Ltd., Leicester, England, 1944; 89 pages, 30*s*.

Research work on the measurement of surface finishes by stylus instruments, carried out at Taylor-Hobson Research Laboratories, is reported. The book deals with those parts of research bearing on the everyday use of such instruments. Sections of the report are devoted to the nature of the surface and the kinds of imperfections to be measured; the basic elements of the stylus instrument and the limitations they may impose, particularly on the graph; and the various ways in which a numerical assessment can be secured.

Industrial Purchasing, by Edwin Laird Cady; John Wiley and Sons, Inc., New York, 1945; 256 pages, $2.75.

Ways by which the purchasing agent may obtain the best results from his work with suppliers and the salesmen who represent them are set forth in this book. It has been written not only for the purchasing agent himself, but also for those who must work for, with, or through him. The book is also suitable for the use of college students who wish to obtain a broad view of the entire business picture.

The New Applied Mathematics, by Sidney J. Lasley and Myrtle F. Mudd; Prentice-Hall, Inc., New York, 1945; 431 pages, $2.20.

Written to provide elementary training in the mathematical skills, the third edition of this book is designed to equip high school students for everyday peacetime needs. It is intended to provide the student with a knowledge of the mathematics used in business and industry. Additional chapters dealing with timely subjects have been added.

Practical and Theoretical Photography, by Julian M. Blair; Pitman Publishing Corporation, New York, 1945; 243 pages, $2.50.

In this revised edition of a text on photography, chapters on aerial photography and surveying have been added. Numerous projects are outlined for experimental work. The book is intended for use in college classes in photography and for the general reader.

Modern Turbines, by Louis E. Newman, Allen Keller, John M. Lyons, Lawrence B. Wales, and edited by Louis E. Newman; John Wiley and Sons, Inc., New York, 1944; 175 pages, $2.50.

Information regarding the characteristics of steam turbines and generators, which govern their selection and application, is supplied in this volume. The book deals with the turbines in the range of ratings from 500 to 7,500 kw., which includes those normally used by industrial manufacturers and small utilities. The fundamental characteristics of different types of turbines are explained in sufficient detail to make clear their performance characteristics.

The book is written for engineers who are interested in the selection of the proper turbine for a given application, but who do not wish to make a detailed study of the intricacies of turbine design or the details of turbine maintenance. The material was first published as a series of articles in the *Power Plant Engineering* magazine from September, 1937, to April, 1939. A complete index has been added, and all of the figures have been redrawn, while the text has been edited, revised, and rearranged.

Practical Design for Arc Welding, by Robert E. Kinkead; The Hobart Brothers Company, Troy, Ohio, 1945; 1 volume, $3.50.

The greater part of this book is devoted to plates illustrating design ideas for arc welding. A record sheet is provided opposite each plate which can be used to suggest and analyze applications of design ideas to the user's own product. To facilitate the use of these plates, a table is provided which indicates the numbers of the various plates that involve certain specific details common in many applications. The fundamental symbols of the American Welding Society and typical applications of the symbols are also shown.

Air World of Tomorrow, by Capt. E. Cecil Evans Fox; The Aeronautical Institute of Canada, Toronto, Ont., 1945; 48 pages, $1.00.

One of a series of booklets on the general subject of aeronautics contains a group of articles written in narrative style, in some of which reference is made to certain aspects of elementary aircraft design.

The Drainage of Airports, by W. W. Horner; University of Illinois, Urbana, Ill., 1944; 48 pages, $0.50.

This circular on the subject of airport drainage is based on a lecture given by W. W. Horner, consulting engineer, to the staff and students of the Civil Engineering Department of the University of Illinois. Following introductory remarks on the objectives of airport drainage and the source of water supply, the problems of subsurface and surface water drainage are discussed.

Bibliography of Industrial Engineering and Management Literature, by Ralph M. Barnes and Norma A. Englert; Wm. C. Brown Company, Dubuque, Iowa, 1945; 113 pages, $1.50.

The main sections of a bibliography on industrial engineering and management literature bring the publications up to January 1, 1943. First prepared to aid in the arrangement of special courses of study for advanced students, this bibliography of books, bulletins, articles, and papers was later expanded for use in a summer management course and for war training programs. Two supplements bring the list of publications up to January 1, 1945.

Principles of Radio, by Keith Henney; John Wiley and Sons, Inc., New York, 1945; 534 pages, $3.50.

This is the fifth edition of a practical textbook on radio. To keep pace with such developments as frequency-modulation broadcasting, microwaves, wave guides, the measurement of distances by radio, transients, and Klystron tubes, new material has been added.

Organizing for Contract Terminations, by J. K. Rosenblatt; Institute of Products Research, Los Angeles, 1944; 92 pages, $5.00.

The necessary forms and procedures for contract cancellations and terminations are supplied in this instruction manual. Suggestions are made for the organization of a contract-termination department, outlining the procedures to be established and the duties of the personnel, with organization charts. One appendix contains reproductions of forms, telegrams, and other notices. Another appendix outlines the provisions of Federal laws and directives governing contract terminations and settlements. A third appendix gives the full wording of six resolutions and one letter concerning property disposition as promulgated by the War Contract Termination Committee of the Aircraft Parts Manufacturers Association.

A Course of Pure Mathematics, by G. H. Hardy; The Macmillan Company, New York, 1945; 503 pages, $4.25.

This is the ninth edition of a book on pure mathematics designed primarily for the use of first year students at universities. Some passages in the first two chapters have been altered, minor errors have been corrected, and a few additional references have been included.

Methods in Climatology, by Victor Conrad; Harvard University Press, Cambridge, Mass., 1944; 228 pages, $4.00.

This book has been written to show how climatologic investigations may contribute to military strategy. It explains how the records of the climatologic observer may be used scientifically and critically to produce a quantitative analysis and qualitative description of the climate in question. The elements and elementary methods of the science of climates are discussed first, followed by numerical and graphic methods of representing the different elements with respect to time and space. In conclusion, the arrangement and composition of a climatography are sketched, and the value of carefully chosen photographs which effectively illustrate and stress the numerical results is emphasized.

The Wings Club Year Book, 1943–1944; The Wings Club, Inc., New York, 1944; 70 pages.

This yearbook contains an account of the activities of the Wings Club, Inc., for 1943–1944. It gives a list of officers, members of the Council, Committee members, and club members; the certificate of incorporation; the constitution; and other information of interest to members.

The Analytical Theory of Heat, by Joseph Fourier, translated with notes by Alexander Freeman; G. E. Stechert & Company, New York, 1945; 466 pages, $5.00.

In translating into English this book on the theory of heat, which was published in 1878, the translator has followed faithfully the French original. He has also appended footnotes containing references to other writings.

Upper Air Trajectories and Weather Forecasting, by Dave Fultz; University of Chicago Press, Chicago, 1945; 123 pages, $2.50.

A report on an attempt to improve forecasting of the surface and upper pressure distributions by means of a trajectory technique applied primarily to the 10,000-ft. chart in coordination with such other aids as are ordinary or were found useful. The project was initiated by Prof. C.-G. Rossby, of the University of Chicago, to develop practical means of utilizing prognostically the paths of particles in the free atmosphere as computed from the assumption of constant absolute vorticity. The report gives some of the theoretic principles involved, an idea of the procedure so far developed, some empiric ideas that seem to be useful, and an account of the verification obtained.

Revised Geometry of the Aerial Photograph, by Earl Church; Syracuse University, Syracuse, N.Y., 1945; 56 pages.

In this bulletin the geometry of aerial photography has been revised to facilitate the practical computations of photogrammetric problems, and to provide a basis for developing rather far-reaching principles concerning so-called trimetrogon photographs. The bulletin is the fifteenth in a series on aerial photography published by Syracuse University.

Aircraft Industry in Chicago; The Chicago Association of Commerce, Chicago, 1945; 180 pages.

The 1945 edition of this directory of Chicago's aircraft industry has been issued. A large part of the volume is devoted to a classified list of the aviation trades.

A Treatise on Dynamics of a Particle, by Edward John Routh; G. E. Stechert & Company, New York, 1945; 417 pages, $5.00.

The fundamental laws of dynamics are given in a reprint of a book originally published in 1898. Elementary and advanced methods of solving problems connected with the dynamics of a particle are explained. The chapters are as follows: Elementary Considerations; Rectilinear Motion; Motion of Projectiles; Constrained Motion in Two Dimensions; Motion in Two Dimensions; Central Forces; Motion in Three Dimensions; Some Special Problems.

A Bibliography of Visual Literature 1939–1944, compiled by John F. Fulton, Phebe M. Hoff, and Henrietta T. Perkins; Charles C Thomas, Springfield, Ill., 1945; 117 pages, $3.00.

A classified bibliography consolidates references to the published matter on vision which has relevance in military operations. The work was undertaken at the initial request of the British Air Ministry and was carried out by a committee of the National Research Council acting for the Office of Scientific Research and Development, in cooperation with Yale University.

The classification is based primarily on presumed military usefulness. The principal sections are as follows: Anatomy and Ophthalmology; Physiology and Psychology; Visual Examination and Testing (Including Methods and Instruments); Correction of Ocular Defects in Military Personnel; Training for Military Specialties (Including Optimal Conditions and Procedures, Job Analyses); Ocular Trauma (in Military Services); Goggles and Ocular Protection; Illumination; Visibility.

The Role of the States in Postwar Aviation, prepared by Patricia L. Waterman; Bureau of Public Administration, University of California, Berkeley, Calif., 1945; 58 pages, $0.50.

This is one of a series of reviews prepared at the request of California legislators. Sections are devoted to the need for Federal, state, and local aviation regulation; proposals for the Federal Aid Airport Program; existing state aviation legislation; recommended state aviation legislation; a bibliography; and tables containing the names of state aviation agencies and other information.

Index to A.S.T.M. Standards Including Tentative Standards; American Society for Testing Materials, Philadelphia, 1944; 211 pages.

The 1944 issue of the index to A.S.T.M. Standards has been published. This index is used as a ready reference for locating any A.S.T.M. standard in the bound publication in which it appears.

Blue Book of Airplane Parts, issued by the Traffic Service, Aircraft Industries Association of America, Inc., Washington, D.C., 1945; 23 pages.

A new issue of the Blue Book of Airplane Parts, which supersedes the August, 1944, issue, has been published. It contains the trade nomenclature, bill of lading descriptions, item numbers of aircraft parts, and an index for the articles listed.

Star Altitude Curves, Latitudes 70° to 90° North and New Line of Position Tables, by P. V. H. Weems; Weems System of Navigation, Annapolis, Md., 1945; 57 pages.

Another of a series of books containing star-altitude curves gives them for the range of 70° to 90° north latitude, including text on polar navigation. It completes a series giving altitudes from 50° south to the North Pole.

The principle on which the star-altitude curves are constructed is that for any time and place there is only one altitude of any fixed star; for any place and sidereal time, the circle of altitude remains nearly the same from year to year.

Intersecting circles of equal altitude for two bodies taken at the same time determine two positions, but usually these two positions are so far apart that one of them can be dismissed as impossible. The circles of equal altitude are plotted on a Mercator chart against latitude and local sidereal time. A fix may be obtained from the altitude curves of two or of three stars in about 2 min. and without reference to right ascension, declination, hour angle, azimuth, or dead reckoning positions, and without the use of the Nautical Almanac or other tables.

In addition to the curves and relevant tabulated figures, the book contains instructions for their use and gives examples, with their solutions.

Fiction and Juvenile Books

Red Randall in Burma, by R. Sidney Bowen; Grosset & Dunlap, New York, 1945; 210 pages, $0.60.

After his experiences over Tokyo, at Midway, on New Guinea, and in the Aleutians, R. Sidney Bowen takes Red and his pal Jimmy Joyce to Burma. On the way they are captured by a Japanese submarine but they escape with important information from another captive, an R.A.F. pilot. This information enables a rescue squadron to locate and evacuate a lost group in Burma.

The Flying Jet, by Canfield Cook; Grosset & Dunlap, New York, 1945; 210 pages, $0.60.

A mysterious expert on jet propulsion is flown from Washington to England, where he is kidnapped by the Germans and taken to their center of jet development in Germany. The English underground learns of this location and sends a plane to pinpoint its relative position so that it can be bombed. The jet expert is found and flown back to England.

The English used jet propelled planes and their combat experiences with the enemy make the tale one of current interest.

Whatever Goes Up, by Bertram Millhauser; Doubleday, Doran and Company, Inc., New York, 1945; 190 pages, $2.00.

This murder mystery story has all the suspense and novelty of such thrillers. A ghostly face peering into the port hole of a China Clipper at night, captive balloons cut away from a tug, a rich man and a pretty grandniece from Honolulu, the inevitable private sleuth, and the mysterious actions of servants make the ingredients of the mixture of Crime Club fiction.

Services of the Aeronautical Archives of the Institute of the Aeronautical Sciences

The services of the Aeronautical Archives are available to all members of the Institute, to Corporate Members, to advertisers in the AERONAUTICAL ENGINEERING REVIEW and, under usual library limitations to the public. Four specialized services are available.

The Paul Kollsman Library

This lending library service makes available, *without charge*, the latest and more important aeronautical books.

As far as the facilities permit, any person in the United States over 18 years of age who can furnish references that certify to his or her responsibility may become a member of the library.

Members may request the loan of any aeronautical or technical book they wish to borrow. Through an exchange agreement with the Engineering Societies Library, any book on general engineering may be borrowed from its great collection of over 160,000 volumes.

A photostating service is available at usual library rates.

Applications for membership in the library and further information will be sent on request.

The Burden Reference Library

This reference library contains over 14,000 aeronautical books, magazines, pamphlets, photographs, reports, and clippings gathered from world-wide sources and is one of the most complete aeronautical libraries in the world. Material from this library is not available for loan but may be used for reference purposes at the Aeronautical Archives.

The Pacific Aeronautical Library
6715 Hollywood Boulevard
Hollywood, California

Established in cooperation with the aircraft companies the library serves. The leading aircraft companies in or near Los Angeles participate in its support and operation.

This service library for aeronautical research is available to the public for reading privileges. Source material includes aerodynamic and structural research reports, as well as books on drafting, production methods, history, and allied sciences. It furnishes books, periodicals, and pamphlet material to the participating aircraft companies to supplement their engineering libraries.

The Aeronautical Archives Technical Information Service

This service has experienced personnel under the supervision of trained aeronautical engineers to compile any information desired. The services range from listing specialized reference books to the preparation of exhaustive bibliographies, digesting of reports, and general surveys of any aeronautical subject. Some of the available services are:

Bibliographies on any aeronautical subject.
Reports on any aeronautical subject.
Digests of aeronautical books, papers, periodicals, and references.
Translations.
Engineering investigations of special aeronautical subjects.
Biographies of individuals engaged in aeronautics.
Photostats of any aeronautical or general engineering material.
Microfilms made on special order.
Photographs made from the Institute's photographic collection.
Drawings and tracings made.

In addition to the services mentioned any commission which comes within the scope of the Service will be accepted. Special arrangements may be made for work requiring several weeks or months.

Translators are available for accurate transcriptions of all foreign language data. Translations are carefully edited by trained engineers.

Reproductions of any material in the Aeronautical Archives of the Institute may be ordered at standard photostat rates.

INSTITUTE OF THE AERONAUTICAL SCIENCES
1505 RCA BUILDING WEST
30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

they wanted

to keep a flying plane GROUNDED!

The job called for a small metal stamping.

In use, it would be fitted around engine oil lines to provide a protecting ground to the frame.

It had to be rustproof.

It had to be readily brazed or welded to the steel oil line tubing.

And, it had to be strong and tough enough to withstand the combined fatigue of vibration and rapid temperature changes.

The first metal tried by the Fitzsimons Manufacturing Company, Detroit, met all these conditions, save one—it could not be satisfactorily brazed to steel.

The next attempt was to use a metal that could be *made* rustproof by coating after brazing. But, lack of workable stop-off devices plus pin-holes in the coating ran the reject rate to 20-30%.

Finally, Fitzsimons' engineers turned to the INCO Nickel Alloys... chose Monel... and ended their troubles. Monel was strong, rustproof, and could be brazed perfectly to the steel tubing.

Perhaps *you,* too, have a problem that could be solved by the unique *combination of properties* obtainable with INCO Nickel Alloys. Strong, tough and corrosion-resistant as a family, each also supplies the individual characteristics needed for specific jobs.

And, *equally important,* these high-Nickel alloys can be readily welded, brazed or soldered. Helpful working instructions are in *"Welding, Brazing and Soft Soldering of Monel, Nickel and Inconel."* For your copy, write: The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.

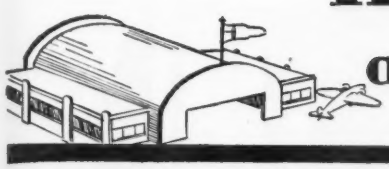
NICKEL INCO TRADE MARK **ALLOYS**

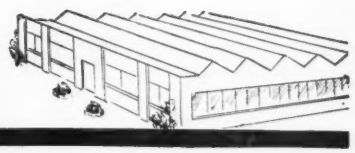
MONEL* • "K" MONEL* • "S" MONEL* • "R" MONEL* • "KR" MONEL* • INCONEL* • "Z" NICKEL* • NICKEL

Sheet... Strip... Rod... Tubing... Wire... Castings... Welding Rods (Gas and Electric)

*Reg. U. S. Pat. Off.

House Organs and Catalogues





Airport Equipment

Hangars and Docks for Douglas Transports. The purpose of a booklet of 20 pages is to explain and illustrate new ideas in the design of hangars and in the development of equipment for handling aircraft on the ground. Designs of hangars are suggested, with estimated costs, plans, and elevations. Another type of building is one that provides semishelter, making it possible to enclose those parts of a large airplane upon which work is being done, while others extend out into the open air. Service docks based on equipment developed by manufacturers for assembly-line operations are also described, as well as equipment for handling engines and a method for jacking aircraft during weighing operations. *Douglas Aircraft Company, Inc.*

Rocket Take-Off for Flying Fortress

B-17 Rocket Ship. The story is told of how a B-17, which could not take off from a field in England by normal means, was catapulted from a short runway with the aid of rockets. It is suggested that this successful experiment with the B-17 as a rocket plane may reveal other uses for rocket-assisted Flying Fortresses. *Boeing Magazine,* July, 1945.

Flow-Rate Measurement Booklet

A New Era in Flow Rate Measurement discusses and illustrates the advantages of the Rotameter for flow-rate measurement. Besides demonstrating how the Rotameter functions, this catalog describes its accuracy, its linear-flow curve, its flow range, the ready visibility of the metering elements and fluid, and its immunity to variations in viscosity and specific gravity. *Catalog Section 10-C,* Third Edition. *Fischer & Porter Company,* Hatboro, Pa.

Self-Leveling Hoists

Hoists for Safety is a 4-page illustrated bulletin giving a brief description of the features of the Safe-T-Lift automatic equalizer chain slings, used for lifting bulky materials. The bulletin describes the principles upon which the unit operates, outlines applications for which it is suitable, and contains specifications. *Hercules Sling Company,* Rockford, Ill.

Wood-Boring Machinery

Root Wood Working Machinery, Bulletin No. 131. A 4-page folder contains illustrations of numerous types of multiple-boring machines suitable for use in drilling wood, plastics, metals, and composition materials. It includes machines for horizontal boring, as well as vertical boring operations. *B. M. Root Company,* York, Pa.

Engine Model Shop

Custom Tailor for Power. An article on the Wright Aeronautical Corporation's model shop. The activities of the shop are outlined, with data given on the procedures followed and the equipment used. *Trade Winds,* June, 1945.

Aeronautical Equipment Catalog

1945–1946 Catalog of Navigation Equipment and Aeronautical Supplies. A 33-page booklet brings together brief descriptions and illustrations of numerous items of air-navigation equipment and supplies produced by various manufacturers. Also are listed various technical books dealing with aerial navigation and related subjects. *Pan American Navigation Service,* North Hollywood, Calif.

Services Performed by Optical Equipment

Seeing It Through is an illustrated booklet of 56 pages explaining some of the functions performed by optical equipment in connection with the war efforts of the nation. It gives brief information about the manufacture of optical glasses and the use of aerial cameras and other items of photographic equipment in industrial plants and among the armed forces operating on the land, at sea, and in the air. *Bausch & Lomb Optical Company,* Rochester, N.Y.

Metal Company's Products and Facilities

Bulletin 71. A survey of the products, facilities, and services of Ampco Metal, Inc. A description is given of how the company designs and produces copper-base alloy products. *Ampco Metal, Inc.,* Milwaukee.

History of an Aircraft Company

Highlights. Outstanding events in the history of the Bell Aircraft Corporation are recorded in outline form. The review indicates the highlights in each year, beginning with 1935 and progressing to 1945. Two charts demonstrate the growth of the company's plant facilities and number of employees during the 10 years. *The Bellringer,* July, 1945.

Soldering Irons for Industrial Use

Electric Soldering Irons. General information and descriptive data about a line of electric soldering irons for use with batteries are given in a 4-page illustrated folder. Prices are listed for the various items in the line, as well as for replacement parts. *Hexacon Electric Company,* Roselle Park, N.J.

Permanent Mold Castings

Reference Data Bulletin PMC 45 was written to provide designing engineers, production executives, and metallurgists with information on permanent-mold castings. This 20-page review points out advantages of aluminum castings with respect to cost, design, and strength. Suggestions are offered to facilitate the designing of parts for the permanent-mold casting process. Four tables are included which give the nominal composition and physical properties of Permold aluminum-base alloys and the nominal composition and physical properties of Permold aluminum-base sand-cast alloys. Various applications of permanent-mold castings are illustrated by photographs of different parts. *The Permold Company,* Medina, Ohio.

Aircraft-Control Principles for Artificial Limbs

Northrop Project 17. The story is related of how aircraft designers and mechanics, at the request of the U.S. Army Medical Corps, applied their knowledge and the facilities of their specialized field to aid in the development of artificial arms and legs for war veterans. It traces the origin of the project, crediting Col. John J. Loutzenheiser, orthopedic consultant for the 9th Service Command, and John K. Northrop and other members of the Northrop Aircraft, Inc., organization for applying aircraft-control techniques to the production of artificial-limb control apparatus. The services of Northrop scientists and Army officers are reviewed in a description of the apparatus developed and the solution of the many problems that were overcome. Particular mention is made of the services rendered by Army pilots who volunteered to test the devices produced to replace their amputated limbs. The illustrations show parts of the apparatus and its installation and use by these "test pilots." *The Northrop News,* July 4, 1945.

YES, SIR, ROOM 915's right next to the elevators, but guests sleep soundly and undisturbed. Elevator doors don't slam at the Gresham Arms, and they needn't slam in other buildings. Bumpers made of VINYLITE elastic plastics quietly absorb the shocks as doors fly open and swiftly close. And similarly, in bumpers for the doors, frames, and hoods of cars and trucks, these same plastics keep their resilience and show no appreciable wear over long periods of time.

VINYLITE elastic plastics are the outstanding material for almost countless products ranging from tiny grommets to electrical insulation for heavy cables. Along with its elastomeric qualities it is non-flammable or flame resisting, remarkably tough, and long lasting. It is highly resistant to sunlight, moisture, abrasion, grease, gasoline, and most chemicals. And VINYLITE elastic plastics are available as molding and extrusion compounds, as flexible sheeting and film, as compounds for coating cloth and paper—in bright colors and pastel tints — transparent, translucent, and opaque.

Bumpers made of VINYLITE elastic plastics by Electric Auto-Lite Company, Bay Manufacturing Division. They include a force-fit bumper; a bumper with a molded insert; another with a molded thread; and a flat bumper.

For applications that need or would be improved by elastomeric qualities, specify VINYLITE elastic plastics. Write Department 12 for detailed information.

BAKELITE CORPORATION
Unit of
Union Carbide and Carbon Corporation
UCC
30 EAST 42ND STREET, NEW YORK 17, N.Y.

Vinylite Plastics

TRADE-MARK

Maintenance Procedures

Air Liner Maintenance—The Why of Airline Safety Records. An illustrated booklet portrays the procedures followed in the maintenance shops of air lines. By means of photographic reproductions and explanatory captions numerous operations involved in airframe and engine maintenance are explained. *Gulf Oil Corporation.*

Illuminated Magnifier

Scherr Magni-Ray is described and illustrated in a 4-page leaflet. The device combines a magnifying lens with a source of illumination in such a way as to throw intense light on an object under inspection. *George Scherr Company, Inc.*, New York.

Materials for B-29

Material Problems Solved in a Superfortress. The metallurgy involved in the production of the Superfortress is discussed. It is noted that before the designers of the component units could assume their responsibilities they had to know what could be expected of the materials. This problem went all the way down the line to controls minute in size but important with regard to reliability of performance. It is stated that the number of metals and alloys used in the Superfortress run into the thousands and include practically all of the metallic elements from platinum, silver, and other precious substances to iron. Reference is made to the many nickel-bearing materials that were used because of their versatile characteristics. How stainless steel, Inconel, and nickel-bearing cast irons are employed in the turbo-superchargers is described. Information is given about the use of welded nickel-chromium-molybdenum steel in the construction of the frame for the nose of the B-29. *Inco*, Vol. XIX, No. 4.

Applications of Pumps

Deming Pumps Everywhere. Progress in the development of pumping equipment for a wide variety of uses is traced in an illustrated booklet showing some of the benefits derived from modern pumping equipment. Uses of pumps in agriculture, homes, factories, mines, ships, and elsewhere are described and illustrated. A section shows various applications of pumps in the aeronautical industries for pumping water, fuel oil, gasoline, and lubricating oil from points of storage to points of use. *The Deming Company*, Salem, Ohio.

Newspaper Cooperation

Back on the Air Map is a large booklet containing reproductions of newspaper editorials and other items by means of which a metropolitan newspaper conducted a campaign for the completion and opening of a new airport for Philadelphia. It indicates the importance attached to the establishment and maintenance of air-transport facilities for the growth and progress of an important American city. *Philadelphia Record.*

Aircraft Radio

MN-53, 75 Megacycle Marker Receiver for Aircraft is described in a 4-page folder. Specifications are given for two types of marker receivers, with information concerning the operation, power supply, circuit, dimensions, and connections for this type of equipment. *Bendix Radio Division, Bendix Aviation Corporation.*

Cost Analysis for Operating Private Planes

Operating Cost Formulae for Personal Planes. Neil B. Berboth. A suggested method is presented for ascertaining operating costs for personal aircraft of from two- to five-passenger capacity. The developed fomulas are based upon averages and, applied to five hypothetical aircraft of representative types, show that annual operating expenses would vary from 50 to 70 per cent of original selling price, depending upon the size of the airplane. By development of these formulas, it is explained also why the lowest-price airplane is not necessarily the most efficient in terms of dollars per plane mile. *The Pegasus*, August, 1945.

Power-Testing Equipment

Dillon Dynamometer is a manual presenting the story of the traction-type dynamometer and the uses to which it is applicable in simplifying testing and weighing procedures in various industries. It describes the construction and operating principles of the device and shows numerous specific applications. One of these is an arrangement used at Republic Aviation Corporation for measuring stresses on wing structures, tail assemblies, and other components of aircraft. *W. C. Dillon & Company, Inc.*, Chicago.

Automatic-Pilot Catalog

Automatic Flight by Honeywell is an illustrated, 8-page catalog describing the Honeywell Autopilot for transport aircraft. It outlines the functions performed by the instrument and gives brief instructions for operating and maintaining the equipment. *File 31-1, Minneapolis-Honeywell Regulator Company, Aeronautical Department*, Minneapolis.

Aircraft Communication System

United Air Lines' Reperforator Switching System. R. E. Hanford. Details are given about the extensive communication system developed for and used by United Air Lines, Inc., by means of which contact is maintained with airplanes in flight. The facilities of the Western Union Telegraph Company are utilized. The article describes the telegraph equipment used, including special perforating machines, tape transmitters, and other apparatus. The construction and operation of the transmission and receiving equipment and its circuit connections are discussed at length. *Electrical Communication*, Vol. 22, No. 3.

Electrical Connectors

E-I Multiple Headers and Sealed Leads are described and illustrated in a 6-page folder. It contains data and specifications for hermetically sealed multiple headers and terminals for electrical components. Construction and application of these devices are described and illustrated by drawings. *Electrical Industries, Inc.*, Newark, N.J.

To Resist Corrosion

Corrosion Resistant Materials and Equipment is the title of Bulletin H, which describes briefly some materials and equipment designed for use where protection must be provided against corrosion. It describes Tygon plastic compounds, tanks and lining materials, compounds to tubing and gasketing, chemical stoneware, corrosion-resistance to masonry, and other materials. *The U. S. Stoneware Company*, Akron, Ohio.

Parachutes

Switlik Safe-T-Chutes. In a 52-page brochure information is given about the operating principles, designs, and use of a line of parachutes. General specifications for these parachutes, the tests to which they are submitted, and the type certificate awarded each model are reviewed. Special sections of the book are devoted to a discussion of the inspection and maintenance of the parachutes and instructions for packing them. Some brief data are included about the history and membership of the Caterpillar Club. *Switlik Parachute Company*, Trenton, N.J.

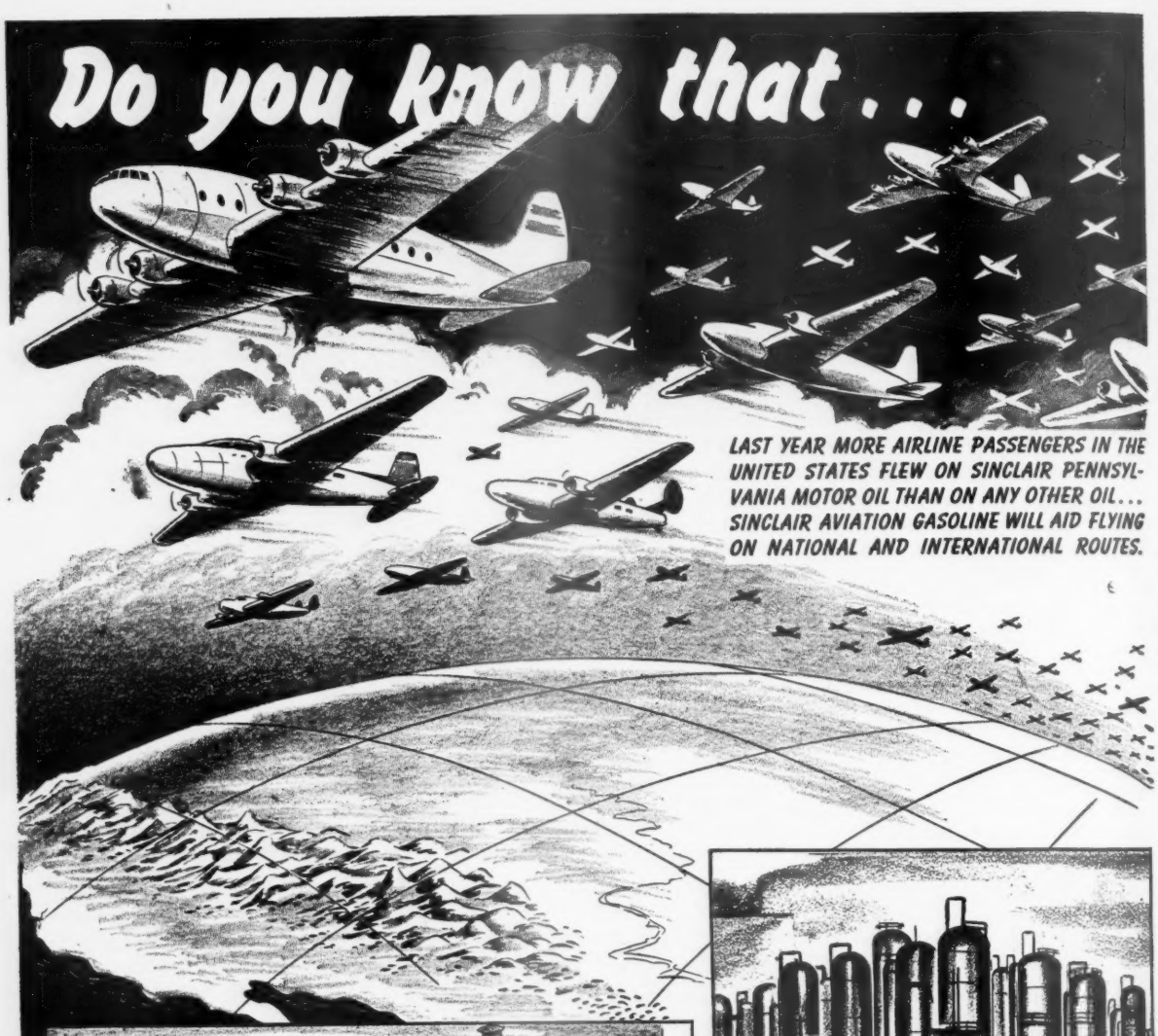
Theory of Flow-Rate Measurement

Theory of the Rotameter constitutes the manufacturer's catalog Section 98-Y, a revised edition containing certain changes and bringing up to date the information concerning this type of equipment. It includes such subjects as the history and technique of the development of area-type flowmeters and an explanation of how the Ultra-Stablvis rotameter is designed to overcome the effects of viscosity and density in flow-rate measurement. Technical and engineering data are given, together with diagrams and illustrations explaining the particular advantages of the apparatus described. Charts show some of the technical calculations and their applications. *Fischer & Porter Company*, Hatboro, Pa.

Principles of Electronics

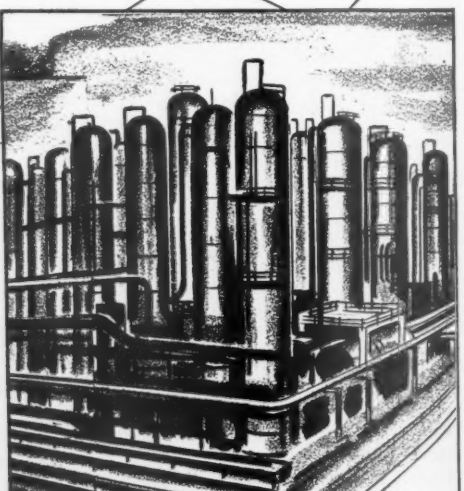
Introduction to Electronics. A guide to understanding the principles of electronics and the part electronics will play in future industrial developments is provided in a 20-page bulletin numbered E6358. A brief discussion about the fundamentals of conversion and control of electric power prefaces an introduction of the subject of electron tubes. Approaching this subject as a guide for application engineers, instead of tube designers, the book explains that the electron tube is a new control element corresponding to a special type of rheo-

Do you know that . . .



LAST YEAR MORE AIRLINE PASSENGERS IN THE UNITED STATES FLEW ON SINCLAIR PENNSYLVANIA MOTOR OIL THAN ON ANY OTHER OIL . . . SINCLAIR AVIATION GASOLINE WILL AID FLYING ON NATIONAL AND INTERNATIONAL ROUTES.

SINCLAIR TANK TRUCKS OPERATE OUT OF 2000 WHOLESALE BULK PLANTS WHICH SERVICE INDUSTRIAL PLANTS, AS WELL AS MANY THOUSANDS OF SINCLAIR DEALER STATIONS, WITH PETROLEUM PRODUCTS.



SINCLAIR REFINERIES PRODUCE SUFFICIENT 100-OCTANE GASOLINE TO COMPLETELY FUEL A FLEET OF 500 GIANT SUPERFORTRESSES FOR A LONG DISTANCE RAID WEEKLY. SINCLAIR AVIATION GASOLINE WILL AID COMMERCIAL FLYING ON NATIONAL AND INTERNATIONAL ROUTES.

SINCLAIR AVIATION OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

stat or switch. The discussion of tubes is divided into two main parts: vacuum and gaseous.

Differences between a vacuum tube and the equivalent mechanical device, methods of specifying tube performance, application of tube characteristics for design purposes, and use of the high-speed response of the tube are explained. Principles of tube detector action with applications, as well as principles of tube oscillators with application to induction and dielectric heating, are presented. Line drawings, curves, and sketches add materially to comprehension of the subject. *Allis-Chalmers Manufacturing Company*, Milwaukee.

Selection of Radio Shock Mounts

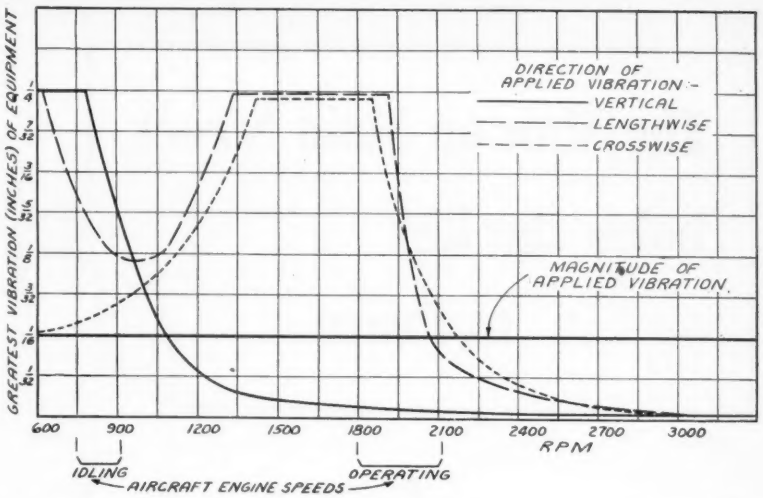
Aircraft Radio Shockmounting. J. H. Best. The writer supplies design information that will aid the aircraft-instrument engineer in selecting the best available radio shock-mounting unit for a particular application. The principles of vibration isolation and the functions of the shock mounts are explained. Factors affecting the selection and location of the mounts are discussed. *Bendix Radio Engineer*, July, 1945.

Precision Grinding and Finishing

A Faster Better Finishing Method for Metal, Plastic or Glass. A new 12-page booklet describes the 3-M Wetordry Method of precision grinding and finishing at high speeds. The booklet explains, in nontechnical language, how this grinding and finishing method keeps operating heat at a minimum; eliminates distortion, discoloration and plastic flow; increases the life of abrasive belts; and eliminates the hazard created by the dust from grinding. Numerous illustrations show actual industrial applications of the 3-M Wetordry Method to problems frequently encountered in grinding and finishing departments. *Minnesota Mining and Manufacturing Company*, Saint Paul, Minn.

Aircraft Arresting Cables

Cables Enable Planes to Land on Carriers. The way in which arresting cables are used to check the speed of aircraft landing on carriers is described and information is given about their development and manufacture. It is noted that the steel cables are stretched across the deck of the carrier and are raised about 6 in. above it when the airplane is about to land. A retractable hook is dropped from the fuselage of the aircraft to which it is attached. When the hook catches one of the cables, the cable pays out under the impact of the hook and at the same time resists the forward movement of the plane. Conflicting requirements for the wire rope were that it had to have high resistance to wear and still be flexible enough to bend around the landing hook. It is stated that the perfected cable is made from a special steel composition, and two operations are required to form it from the wire strands. *US Steel News*, July, 1945.



Vibration test performance of radio equipment mounted on conventional corner-located vertical shear-type mounts.

Aluminum Bronze Products and Techniques

Ampco-Trode Welding Technique, Bulletin W-2. Methods of welding with coated aluminum-bronze weldrod are reviewed. The discussed techniques and recommendations pertain to metallic arc welding, carbon arc welding, and oxyacetylene welding. A weldability chart for copper-base alloys shows the range of metals which can be successfully welded.

Bulletin 64A. Extruded aluminum bronze products are described and illustrated in this bulletin. Covering extruded bronze bars, tubes, and shapes of certain grades of Ampco Metal, Ampcoloy bronze alloys, and Ampco rolled sheet, the bulletin gives prices, lengths, diameter increments, tolerances, weights, physical properties, and similar data. *Ampco Metal, Inc.*, Milwaukee.

History of Instrument-Landing Systems

Development of Aircraft Instrument Landing Systems. H. H. Buttner and A. G. Kandoian. The development of instrument-landing equipment is traced, with particular references to the contributions made by the International Telephone & Telegraph Corporation and its subsidiaries, affiliates, and predecessors.

The various stages in the solution of the problems are listed, with comments about the principles involved and the assistance rendered by various engineers and officers of the Army and Navy who aided in the work, as well as other companies that made their facilities available. Glide-path developments are outlined and the "Indianapolis System" is described. This is followed by a description of the SEC-51 equipment and a discussion of future trends in the development of instrument-landing apparatus. *Electrical Communication*, Vol. 22, No. 3.

Rubber in War

We Had to Have Rubber is a booklet describing the rubber industries' contribution to the war effort. Statistics reveal the great quantities of rubber products which have been channeled to the armed forces. Illustrated with battle action pictures showing rubber at war, the booklet traces the soaring military demands from 1939 to the present. Statistics on airplane-tire production are included. *The Rubber Manufacturers Association, Inc.*, Washington, D.C.

Engineering Company's Products

Directory of Products and Engineering Literature. A directory of products and engineering publications indicates the lines of equipment manufactured by the Allis-Chalmers Manufacturing Company. The major portion of the directory is devoted to a listing of more than 1,600 product types. New products added since the previous directory, such as induction and dielectric heating equipment, are marked by a star for easy identification.

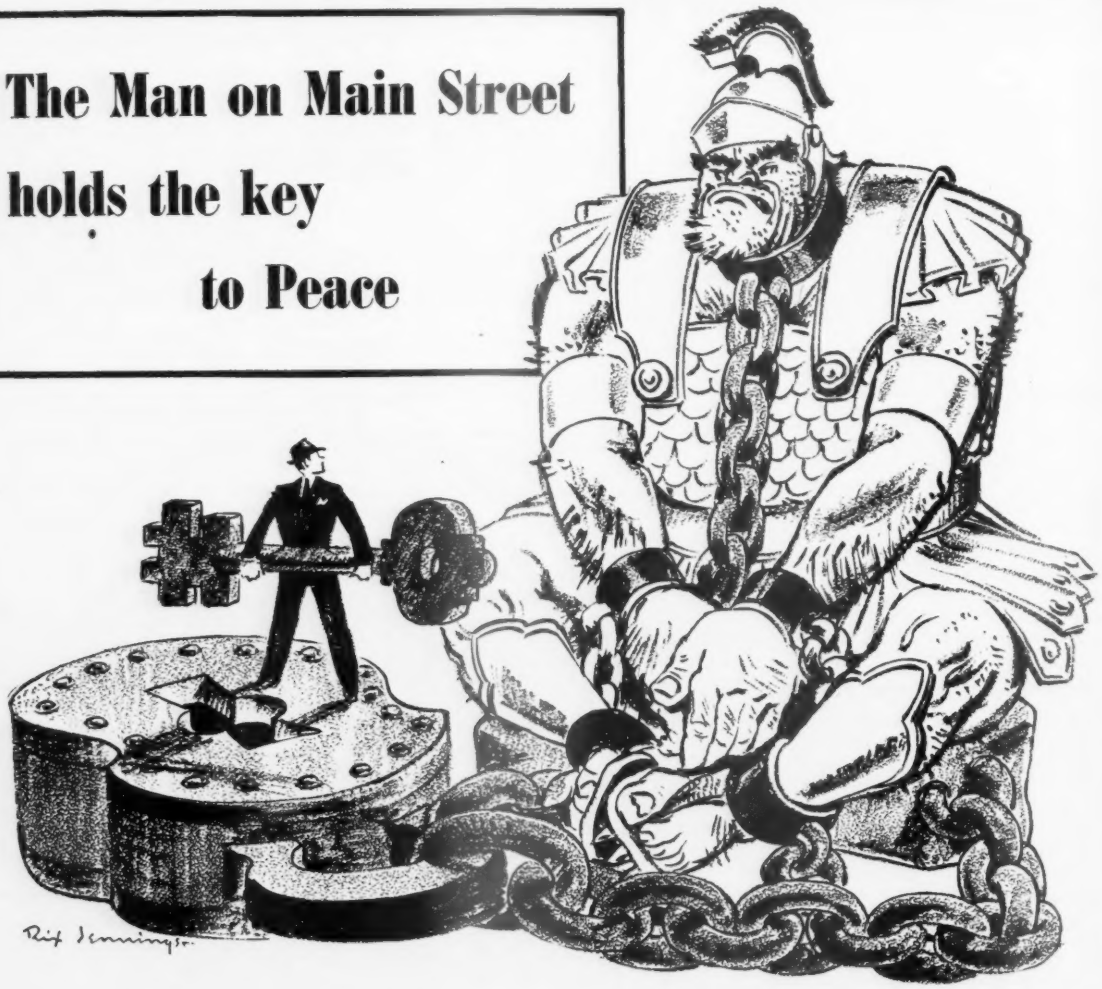
Engineering literature is arranged according to the product discussed, with new bulletins starred. In most cases the publications contain operating data, charts, formulas, and technical information of value to the man who specifies and buys equipment. A business reply card is included for use as a bulletin order blank. The location of domestic and foreign sales offices is given. *Allis-Chalmers Manufacturing Company*, Milwaukee.

Air-Line Radio Equipment

RTA-1B Communication Equipment for Aircraft. A 4-page leaflet provides a general description, transmitter specifications, and receiver specifications for RTA-1B aircraft communication equipment. Developed for air-line requirements, it combines ten crystal-controlled receiver and transmitter channels with integral power supplies into a

This is the second of a series of advertisements concerning the future of Aviation . . . in America

The Man on Main Street holds the key to Peace



JOHN Q. CITIZEN, the Man on Main Street, has a vital stake in post-war aviation. Aviation will provide him with new, world-sweeping utility; he in turn can influence the growth and development of aviation by his lively interest in its affairs. As for National Security, the idea of Permanent Peace Through Air Power is one that can come to achievement only through public support.

Americans have already started locking out the wars of the future by personal support of organizations which are trying to keep America active and strong in the air. As the Germans admitted, when their war was done, Air Power played a major role in the Nazi defeat—and Air Power is strong security against future aggression.

John Q. Citizen has other tools for peace at hand. His interest in private flying, fast transportation, local air terminals, air strips and air parks; his support of air shows and exhibitions; his interest in aviation literature, books, education and research; his participation in aviation organizations . . . all these are specific ways in which he will help make peace through Air Power a reality for this country.

And Bell Aircraft makes a pledge of continuous cooperation. The company will intensify its research and scientific development program which has already brought into being so many aviation *firsts*—the Airacobra and Kingcobra, the "cannon on wings"... America's first jet propelled plane... the first helicopter with built-in, engineered stability. . . representing the kind of aeronautical pioneering which looks to the future—in the skies.

★ *By War Bonds and Speed Victory* ★

MEMBER AIRCRAFT WAR PRODUCTION COUNCIL...EAST COAST, INC.

BELL *Aircraft*

PACEMAKER OF AVIATION PROGRESS

NIAGARA FRONTIER DIVISION
Niagara Falls, N. Y.
Airacobra (P-39) and Kingcobra (P-63)—Fighters
Airacomet—America's First Jet Propelled Plane
The Bell Helicopter

ORDNANCE DIVISION
Burlington, Vt.
Flexible Gun Mounts and other ordnance materials

GEORGIA DIVISION
Marietta, Ga.
Bell Built B-29 Superfortress

© *Bell Aircraft Corporation*

single unit weighing less than 88 lbs. It is normally designed for radio-telephone service but can be adapted to provide continuous wave telegraph transmission and reception. *Bendix Radio Division, Bendix Aviation Corporation.*

Pilots' Plan for Operation of Air Routes

Planning and the Pilot. With fundamentals of the plan outlined, it is suggested that the British Air Line Pilots Association compile and publish a "Pilots' Plan for Operation of Air Routes." Sections into which the plan would be divided are recommended as follows: (1) type of aircraft for immediate use and for use when the postwar types can be delivered; (2) type of schedule to be operated, detailing hours of flying per 24 hours, maintenance schedules, changeover stations for crews and aircraft, number of crew members; (3) general engineering organization in the air and on the ground; (4) general traffic organization in the air and on the ground; (5) a statement of radio requirements—aircraft equipment, beams, blind approach and D/F systems, W/T and R/T communication stations with recommended ranges; (6) some observations on general administration with a view to obtaining the maximum degree of staff economy and efficiency of operation; (7) desirability of cooperation, if it could be arranged, with radio officers, engineer officers, and other flying personnel on those matters in which they are particularly interested. *The Log*, June, 1945.

Units for Threaded Assemblies

Bulletin No. 242 describes a screw-thread system consisting of three parts: (1) the screw or stud part threaded with a circular section thread; (2) the helical coil insert of stainless steel or phosphor-bronze wire, with a cross section to fit the circular-section thread on one side and the modified American National tapped thread on the other; (3) the light-metal part, tapped with a truncated Vee thread to receive the insert. Citing the merits of this system, the bulletin also provides design and installation data. Dimensions and specifications are listed for tapped holes, inserts, screws, and studs, and an 8-pitch thread series. *Aircraft Screw Products Company, Inc.*, Long Island City, N.Y.

Ice Prevention on Cargo Transport Plane

Anti-Icing the C-82. Edwin T. McClanahan. Particulars are given about the thermal system of ice prevention employed on the C-82 Packet. In addition to an illustrated report on the features of the system's design and operation, data are included on the history of its development. *The Pegasus*, August, 1945.

Gages for Precision Measurement

Sheffield Visual Gages. A new catalog illustrates and describes visual gages. It shows the various attachments that can be used with the visual gage, making possible a number of different applications.

The discussed gage is an indicating comparator, with either English or metric scale, used for checking external and internal dimensions—width, thickness, height, depth, diameter, taper, out-of-round, concentricity, the angularity of surfaces or angularity between a bore and a surface, and runout. It is used for checking the critical elements of screw threads. Six models are available with magnifications ranging from 500-to-1 to 20,000-to-1. The range of amplifications provides a means of checking master and production gages for toolroom work, for checking purchased parts, for process control and final inspection, and for laboratory and research work. *The Sheffield Corporation*, Dayton, Ohio.

Postwar Dirigibles

Queen of the Skies. Roger Williamson. The question of whether or not the dirigible will have a place in postwar aviation is discussed. Statements of some proponents of this means of air transport are quoted. It is stated that the most important argument for the airship advanced by its proponents is that it might have a 90-ton cargo capacity on a nonstop flight of 2,500 miles, and a 70-ton lift if flown nonstop for 4,000 miles. *Ethyl News*, July-August, 1945.

Plastic Coating

Introducing Liquid Envelope. The properties and applications of a "peelable" plastic film are noted in an illustrated pamphlet. Recommended for the packaging and protection of materials and equipment in transit or in storage, this plastic is reportedly being used for the overseas shipment of aircraft. *Better Finishes and Coatings, Inc.*, Newark, N.J.

Aviation Personality

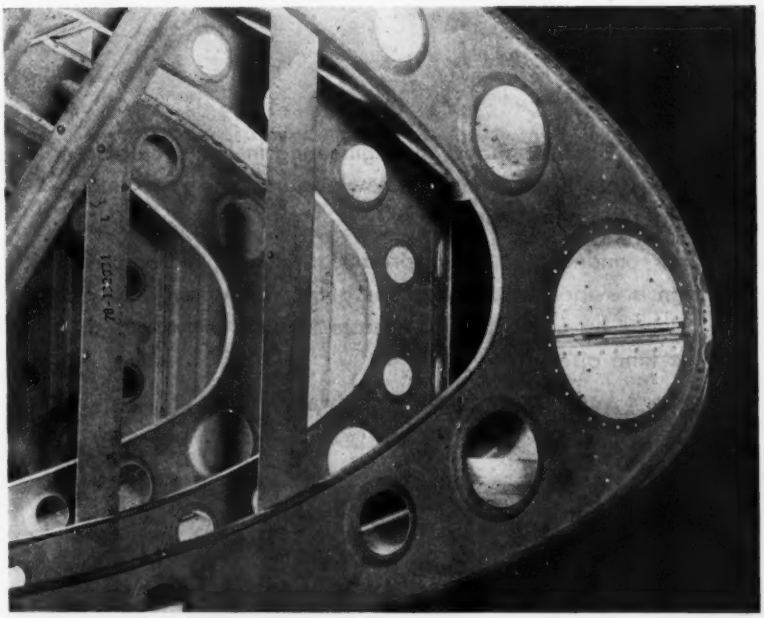
He Started Up in a Balloon. The aviation career of Col. John Hamilton Jouett is outlined. In addition to tracing Colonel Jouett's past affiliations with the industry and noting his present positions as President of Bellanca Aircraft Corporation and Vice-President of Higgins Aircraft, Inc., the article contains mention of his current activities in Mexico, where he is making a transportation survey for the government and banks of that country. *The Southernaire*, June, 1945.

Aviation Gasoline Production

"Fluid" Catalyst is the title of a small 18-page booklet describing a process that is being used to produce 100-octane gasoline for Allied warplanes. It tells how improved catalytic methods are utilized to speed the production of this fuel. *Standard Oil Company (New Jersey).*

Aircraft Radio Equipment

Low Frequency (Beacon and Control Tower), High Frequency (Airways Communications), as well as Very High Frequency (proposed band for all aircraft service) are all available in one transmitter with power outputs ranging from 100 watts at V.H.F. to 190 watts at the lower frequencies. Individual and interchangeable radio-frequency sections make possible a high degree of flexibility. Up to four such sections can be operated by a single control unit, and each H.F. and V.H.F. section may be



Construction of the leading edge of the wing of the Fairchild C-82 Packet, showing the duct at the extreme right through which heated air passes as a function of the hot-air anti-icing system.

pretuned for operation on either of two adjacent channels. If low-frequency operation is not required, therefore, it is possible to operate the TG-16 transmitter on any one of eight pretuned channels using only four R.F. sections and one control unit in addition to the necessary power supply and modulator.

The bulletin gives detailed descriptions of the components and specifications of the complete unit. *Bulletin No. SE-11½*, June 20, 1945, *Bendix Radio Division of Bendix Aviation Corporation.*

Training Courses Offered by Engineering Company

Where Do We Go From Here? An engineering graduate training course permitting exploration by the graduate engineer of production, sales, research, design, field work, administration, and other elements of industrial operation, is described in a new training brochure. Based on the theory that an engineer finds the right job by working at several, the outlined training course coordinates shop and office work in a 2-year program designed to fit individual aims and abilities. A recently-inaugurated company program of graduate study in cooperation with the Illinois Institute of Technology also is discussed. This program involves professional and technical education on the graduate-school level, leading to a master's degree.

The brochure includes data on the activities of Allis-Chalmers' ten departments, a review of American industry "landmarks" engineered by the firm, and maps locating installations around the globe. *Allis-Chalmers Manufacturing Company*, Milwaukee.

Back to the United States via Air Transport

Redeployment by Air. Col. Richard E. Fell. These notes explain how the Army's "Green Project" operates. The project is the transportation by air of military personnel westbound from Europe and North Africa to the United States. It is claimed that more than 50,000 persons per month will be returned to the United States through the services of the A.T.C. *The Pegasus*, August, 1945.

Fuel Injection Nozzle

Bulletin No. 39351. A 12-page booklet about a fuel injection nozzle for Diesel and gasoline engines describes the operation of the nozzle and how it works in relation to these engines. Written for the layman, it is illustrated with photographs and cross-sectional drawings. *Ex-Cell-O Corporation, Fuel Injection Division*, Detroit.

Fuses for Hydraulic Equipment

Simmonds Hydraulic Fuses. A 33-page brochure contains engineering and performance data on three types of hydraulic fuses—a quantity-measuring fuse, a return-flow fuse, and a delayed-action restrictor. Directions for installing and operating these fuses are included. In addition to various charts and drawings illustrating the functions and performance of the fuses, there is a schematic drawing of a hydraulic system showing typical fuse installations. *Simmonds Aerocessories, Inc.*, New York.

Proper Handling of Gasoline

Know-How in Handling Fuels. A brief description is given of how the personnel of the A.T.C.'s Ferrying Division are being taught proper methods of handling gasoline. The purpose of the educational program is to prevent accidents from gasoline, with particular reference to fire and explosive hazards, and to remind trained pilots to use gasoline of proper antiknock rating. The program includes two informal talks given at each meeting, supplemented by two educational films. *Ethyl News*, July-August, 1945.

Tool-Catalog Sections

Engineering Tools. New catalog sections are now available regarding a line of new and improved tools, which includes self-adjusting toggle clamps, A.S.A. drill bushings, machinists tools, and gages. Among the gages described are depth micrometers, surface gages, screw-pitch gages, thickness gages, and engineers' gages. The leaflets also contain information about aircraft tools, dimpling sets, squeezer sets, flush rivet sets, standard rivet sets, speedrivers,

THE basis of *thorough engineering* in Lamb Electric motors is an intimate knowledge of the operating conditions of the product.

The soundness of this approach to special motor design is evidenced by the reputation for dependability gained by Lamb Electric motors in both prewar and wartime operation.

THE LAMB ELECTRIC COMPANY • Kent, Ohio

Lamb Electric
FORMERLY Black & Decker Electric
SPECIAL APPLICATION FRACTIONAL HORSEPOWER MOTORS

Dzus fastener drivers, a drill guide pressure foot, and midget socket sets. Simplified conversion data for jig drill bushings are shown in chart form. *Products Engineering Company*, Beverly Hills, Calif.

Bulletin on "Skin-Recovery" Process

Bulletin No. SC-125 describes the "skin recovery" or carbon restoration process by the use of a controlled gas atmosphere. Application of the process in preventing decarburization of various steels and how it differs from the process of carburization is explained.

The bulletin emphasizes the desired value of maintaining the carbon content of the surface of the material in preventing reduction of its endurance limit under repeated stresses and in often eliminating the need for machining operations subsequent to heat-treatment. Various photomicrographs indicate the effect of the process on several types of steels. Also included are charts that show the unbalanced carbon concentration from surface to core metal obtained by the carburizing process and the balanced condition when the skin-recovery process is used.

To illustrate the difference between normal heat-treatment and the skin-recovery process, there is a chart of Vickers Micro-Hardness for depths up to 0.050 in. for both treatments. It is demonstrated that carbon content of the original material is maintained within 0.03 per cent by the skin-recovery process.

Since the principal requirement in applying the process is that the work be heated in a chamber wherein both air and flue gases can be completely excluded, illustrations are shown of Surface Combustion furnaces of both batch and continuous type in which this requirement is met. *Surface Combustion Corporation*, Toledo, Ohio.

Turret Gun-Sight Design

Needle Bearings in the War's Most Important Electronic-Mechanical Device. The mechanical construction of the Fairchild aircraft turret gun sight, known to the U.S. Army as Model K-8, is described. Particulars are given about the critical functions performed by needle bearings and electronic circuits. Illustrations show the design of this gun sight and the procedure that the gunner must follow when using it. *The Bearing Engineer*, May-June, 1945.

Petroleum Developments

848 Men—And You. Developments and activities of the Socony-Vacuum Oil Company in the petroleum refining and petroleum chemistry fields are depicted in a 46-page booklet. The recorded achievements, facilities, and methods are reviewed according to classifications of gasoline fuels, fuel oils, motor oils, industrial oils, lubricating grease, process products, chemicals from petroleum, and specialties. Some of the company's plans for the future are outlined. *Socony-Vacuum Oil Company, Inc.*

Home-Study Course

Science of Measurement. A "correspondence course" in precision measurement and tool inspection is contained in a series of eight pamphlets. Spaced to cover a 2-months' period of study, the lessons explain the functions, operation, and care of various measuring instruments. Inspection and engineering methods utilizing gages, micrometers, etc., are described. The eight lessons are titled Progress in Precision; Inspection and Care of Gage Blocks; The Uses of Gage Blocks; Accessories of Precision; The Sine Bar and Its Uses; Measuring to a Millionth with Optical Flats; The DoAll Comparator and Threads and Gears; The Mobile Inspection Unit and How to Set Up a System. *The DoAll Trade School*, DesPlaines, Ill.

Liquid Plastics

The Vibron Family, Our Versatile Plastic. These notes tell something about the nature, manufacture, development, and applications of a class of liquid plastics called the Vibrons. Methods and equipment with which they are processed by the U.S. Rubber Company are depicted. Among the applications noted is the use of these plastics for helicopter cabin structures. *US*, July-August, 1945.

Production and Maintenance Suggestions

The Martin Star, July, 1945. (1) Tool for installing nose-rib attaching gussets enables parts to be accurately located by one mechanic and greatly reduces installation time; (2) new-type clamps for tube and conduit-type installations obviates need for tools in installation and removal of objects, prevents loss and breakage of parts, and enables any single tube or conduit to be removed without disturbing other tubes or conduits in a series.

The Transcontinental & Western Air Skyliner, June, 1945. Revised construction of main cabin chair unit, which controls the movement of the seat and back of chair, results in weightsaving and overhaul timesaving.

The Consolidated Vultee Volunteer, July 6, 1945. Simplified spring stripper for die punches.

North Ameri-Kansan, July 6, 1945. Fiber protector prevents scratches on skins of parts and assemblies during spot-weld operations.

Kellett News, July 1, 1945. Combination bucking bar and gage saves manhours.

The Wasp Nest, July, 1945. Humper bar improvement on Foote-Burt multiple drill machine prevents breakage of guides and armatures and saves time.

Edo Log, July 13, 1945. The use of rubber sleeves in place of die springs on side stiffener air punches eliminates spring breakage.

McDonnell Airscoop, July 20, 1945. (1) Method of simultaneously counterboring and countersinking Dzus holes; (2) special-type screw to install nut plates saves 50 per cent time and insures perfect alignment of the nut.

Noorduyn Tale-Spin, July, 1945. (1) Jig for welding tubular legs enables job to be carried out by one welder; (2) adaptation of a wood chisel to an air gun makes work faster and easier; (3) special welding jig is safer for welder and provides better control; (4) alignment jig for elevator collar insures accurate work.

Edo Log, May 30, 1945. (1) Holding fixture insures correct alignment of holes in the center forging with the flap prior to spot welding; (2) combination holding device and drill and scrib jig for deck stiffeners eliminates handling of parts and reduces production time required; (3) guard for knife-sharpener type of deburring tools helps to eliminate cuts from the sharp edges of the sheets caused by slipping of the tool; (4) power polishing tool removes scratches and corrosion from material.

Grumman Plane News, July 26, 1945. (1) Method of making breaker points on spot-welding machines last three or four times longer; (2) drill press attachment simultaneously burrs steel tubing at both ends; (3) special tool for overlap skin trimming; (4) improved tube bender for circular lines.

Edo Log, July 20, 1945. Special bolt enables one man instead of two to fit jay hooks during preliminary drilling operation.

The Goodyear Wingfoot Clan, July 13, 1945. (1) Locating ring for wing skin eliminates difficulties formerly encountered in assembling part; (2) tool for setting pulley bracket locators.

Douglas El Segundo Airview News, July 17, 1945. Strippet punch guide for hat-section angles.

Republic Aviation News, July 20, 1945. (1) Grinding three flats onto angle drill shafts prevents the shafts from slipping in drill-motor chucks and helps eliminate shaft damage; (2) adjustable alignment plate assures accurate alignment of loft templates during the construction of plaster mock-ups and can be used for mock-ups of various widths; (3) wire-nest paint spray barrel for painting small parts saves time.

The Common-Ader, July 5, 1945. (1) Cutting machine for felt pads eliminates process of cutting felt padding with knife and saves time; (2) clamps for bushing on fuselage frame section prevent sand blast from ruining threads of bushing and save time, rework, and spot facing; (3) adjustment device for handling undersize or oversize nailing strips as they are fed into machine.

How do you rate in the AIR-Q test?

If you can answer at least three of the four questions on this page correctly, give yourself an "A" in Aviation. You're one of a steadily increasing number of Americans who realize that, in the future, "Airpower is peacepower."

If Hitler could do it again, which country would he crush first?

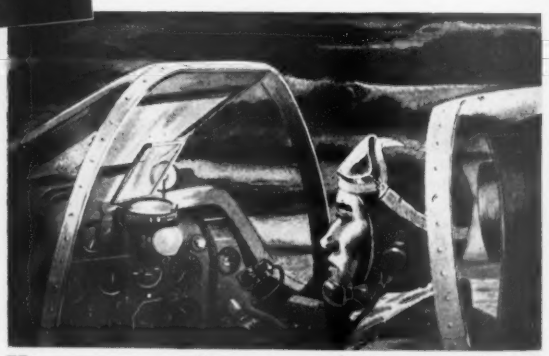
England ☐
America ☐
Russia ☐

Probably America. Evidence: Germany by V-E day had developed aircraft capable of reaching and destroying our homes and factories. Hitler realized too late that it was America's production genius that turned the tide. That's why, in the future, we must always be prepared for a sneak attack. *For maximum security, America must maintain an up-to-date air force.*

How many drawings were needed to design the P-51 Mustang?

100 ☐ **700** ☐ **2800** ☐

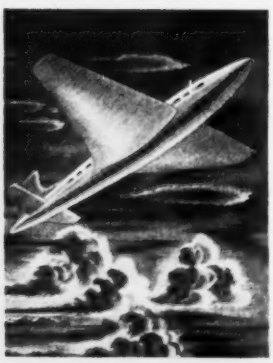
It took 2800 original drawings. Add months of wind-tunnel research, detail engineering, testing, tooling, assembly line set-ups and personnel training and you'll see why it takes more than a year to get a new airplane into quantity production. Wars can begin in a matter of minutes. That's why *it's imperative that tomorrow's planes be designed today!*



How many gadgets in a fighter cockpit?

55 ☐ **70** ☐ **100** ☐

100 or more is the correct answer—and, in a P-51 Mustang, they all fit into a cockpit that's only 35 inches wide! Yet pilots have no trouble finding the right "gadget" at the right time. Through constant research North American engineers scientifically group controls according to frequency of operation. Result: orderly roominess, greater pilot efficiency. *In designing, engineering and producing military planes, North American Aviation sets the pace!*



Will America's future aircraft be:

Rocket-Powered? ☐
Jet-Propelled? ☐
Propeller-Driven? ☐

All three answers are correct—provided we continue development of improved aircraft. North American Aviation engineers are constantly working with new and wonderful aeronautical ideas. They know that *when the aircraft industry is through making changes—it's through!*

North American Aviation

Sets the Pace

DESIGNERS AND BUILDERS of the P-51 Mustang fighter, the B-25 and PBJ Mitchell bomber, the AT-6 and SNJ Texan combat trainer. North American Aviation, Inc. General Offices, Inglewood, California. Member Aircraft War Production Council, Inc.

From the Industry

Three-Range Hydraulic Pressure Regulator

A three-range hydraulic pressure regulator now makes it possible to use one size of valve to meet the pressure requirements of 1,000-, 1,500-, and 3,000-lb. hydraulic systems. Smaller and lighter than conventional types, this valve is stated to be capable of adjustment without disassembly, even with the unit in operation. A port arrangement permits hydraulic-line tubing to lie flat in one plane, eliminating sharp bends that cause faulty hydraulic flow or even failure. The straight line flow also results in an unusually low pressure drop. All parts are interchangeable. No special assemblies are required.

The capacity of the regulator is 16 gal. per min. with $^1/_2$-in. lines, and the regulator operates with accumulator volume as low as 36 cu.in. The temperature range is from −65° to +165°F. A special drain port overcomes the effects of back pressure. It is reported that tests have indicated satisfactory performance with back pressure up to 85 per cent of cut-out pressure. This valve is especially suited to test-stand use where pressure requirements vary. Air Associates, Inc., Teterboro, N.J.

Air-Line Travel Insurance

Greatly improved coverage under air-line travel insurance policies, obtainable at all air-line ticket offices throughout the United States, is now available to passengers traveling on the nation's air lines. Heretofore, policies sold to air-line passengers have given coverage for a stated number of hours of flying time. Now, for the same fee, they will cover completion of the trip within a 7-day period.

A passenger who purchases an air-line travel policy will obtain, for a flat premium of 25 cents, $5,000 insurance while on any trip—regardless of the total number of hours of flying time—between any two points not served by the same airport within the continental United States and into Canada for a distance of 150 miles. A complete round trip, however, is considered two trips, so that a new policy must be obtained to cover the final leg of the trip back to the point of origin.

Within the area specified, a person can be insured for a trip on planes of Canadian registry operated by scheduled air lines, as well as for a trip between any point in that area and any point in Newfoundland via a United States flag air line or Trans-Canada Air Lines. Coverage also extends to travel on air lines within the Hawaiian Islands.

Other features of this insurance include coverage while riding on conveyances operated by common carriers which provide substitute transportation before arrival at the final destination, as well as coverage on land conveyances provided or arranged for by an air line or Governmental authority controlling an airport. Air Press Service, Washington, D.C.

Tool for Combining Operations

Drilling and countersinking, drilling and spot-facing, or drilling and counterboring in one operation is made possible by a new tool known as Drilpilot. Of rigid, simple construction, this tool is made of high-speed steel, carefully ground for close tolerances after hardening. Body of drill is $^5/_8$ in. long with a $^9/_{16}$-in. flute length, thus leaving $^1/_{16}$ in. of solid drill body which acts as a pilot after the hole is drilled. Shank is 0.086 in. in diameter and $^5/_8$ in. long. Usable in place of any standard pilot, Drilpilot comes only in standard rivet sizes—No. 40, No. 30, No. 21, and No. 10.

This tool can be changed over from one job to the next and put through a wide range of operations. In combination with a standard stop countersink or microset stop countersink, it permits drilling and countersinking in one operation to a predetermined diameter of countersinking. Used with standard angle drill adaptors or angle drill attachments, drilling and countersinking or drilling and spot-facing can be performed in most "difficult to reach" places. Drilpilot can be used in connection with a replaceable-shank countersink or replaceable-shank spot-facer, thus combining drilling and countersinking, or spot-facing with hand drill or in drill press. Aircraft Tools, Inc., Los Angeles.

Torque Screw Driver

A torque screw driver for all hand-assembly jobs is intended to be particularly useful for sheet metal, plastics, and light metal work. It is based on the principle of measuring the relative longitudinal displacement of parallel steel bars of a known and indestructible tensile strength. Inch pounds are indicated directly on the dial without the use of springs. The range is from zero to 25 in.lbs., said to be adequate for at least 80 per cent of all applications.

This torque driver comes with two bits, one for Phillips screws and one for slotted screws, together with an adaptor for $^1/_4$-in. square socket to take wrenches for small nuts, studs, and socket screws. The tool is reported to be light and comfortable to use. Apco Mossberg Company, Attleboro, Mass.

Push-Pull Control Unit for Positive Locking

A new push-pull tension lock control offers a positive lock for difficult control jobs. It is claimed that this control will hold any load pressure which can be applied by hand. The control can be used in combination with rods and cables, as well as other flexible or rigid push-pull remote controls.

Consisting of a $^1/_2$-in. steel sleeve with all operating mechanism contained within it, the unit is compact and weighs only 8 oz. The aluminum T-shape control knob is designed for ease of operation and positively locks the control in any position of travel.

Merely pulling out the control head sets the control to any desired position, as the wedge key inside the control wedges itself against the wall of the outer sleeve, preventing the inner sliding member from moving back. Pushing the button on the head of the control depresses a spring that actuates the wedge pin, thus giving it clearance of wall of outer sleeve and permitting the sliding control member to be moved in. Arens Controls, Inc., Chicago.

Locked-In Fastenings Widen Use of Soft Metals and Plastics

A locking system for threaded inserts and studs helps make the use of soft materials practical. Fastening units furnish permanent steel fastening points in any material. They are said to be easy to install and may be removed by

Apco Mossberg torque screw driver. The indicator registers inch-pounds.

a simple shallow drilling operation without disturbing the parent material.

The system operates as follows: A locking ring, which is used on both the insert and the stud, is serrated inside and outside so that its inner teeth integrate with a serrated collar that is on both the insert and the stud. When the ring is pressed or driven into place, its inner teeth engage those of the serrated collar, while the outer teeth broach the wall of a counterbore. The chips fall into the lower part of the counterbore, and the unit becomes an integral part of the parent material, impervious to vibration or torque. Bardwell & McAlister, Inc., Hollywood, Calif.

Rubber Plasticizer

The addition of a new organic material to rubber is said to enable the rubber to remain flexible at extremely low temperatures. Cited as being especially suitable for use in the manufacture of rubber for deicers, fuel hoses, and self-sealing gasoline tanks of military aircraft, the material will be marketed as a rubber plasticizer or softening agent. The plasticizer can be used in both synthetic and natural rubber but is recommended as being most suited to use with oil-resistant rubbers of the acrylonitrile type. Battelle Memorial Institute, Columbus, Ohio.

Emergency Runway Surfacing

Prefabricated asphalt airstrip surface material called "hessian mat" is a Canadian-British development of burlap-type material made of Indian jute. It was used as an emergency surfacing material for airstrips during the invasion of France. Ninth Air Force engineers produced a successful landing surface by using the material as a "roofing" over a well-graded and compact area. Laid from rolls 100 yards long and 1 yard wide, the hessian mat is run through a "stamplicker" consisting of a series of rollers and a rotating drum filled with asphalt. As the stamplicker moves along, the hessian is paid out and laid, completely gummed with asphalt on the bottom side. Each succeeding strip overlaps the one at its side by 50 per cent, producing a mat of two layers of alternate asphalt and hessian.

A 5,000-ft. hessian runway takes an experienced unit about 16 hours to lay, as compared with 20 hours for pierced steel plank. Another advantage is that it takes only 850 tons of hessian to cover a normal-size field as against 4,000 tons of pierced steel plank. Original estimates of the life of a hessian surface operational field was 60 days. But after 60 days of operation of a field where 300 loaded C-47's were landing and taking off every day, the surface is reported to have shown no appreciable wear. Bonafide Genasco, Inc., New York.

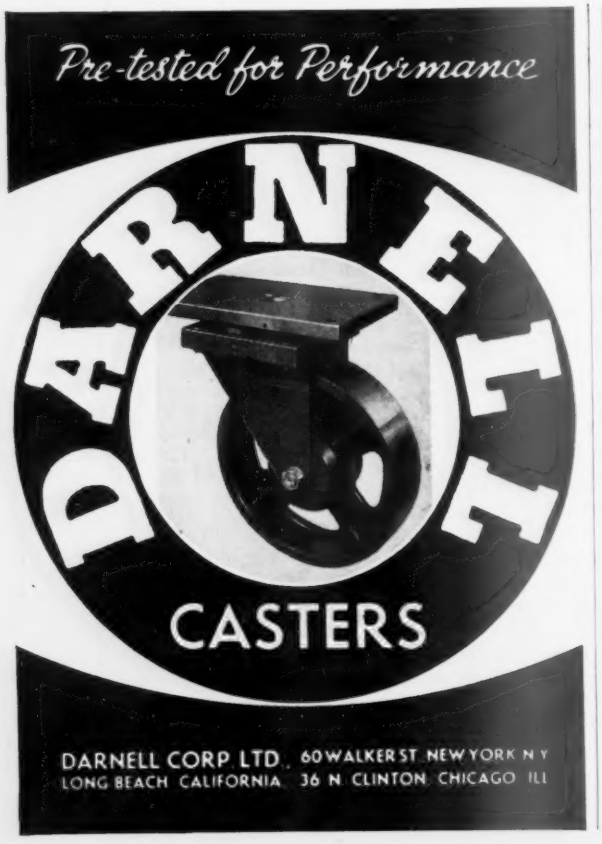
Industrial Control Assemblies to Add Portability Feature

Improved portability of industrial instruments is reported to have been obtained through improvements consisting of assemblies, comprising handles and parts, furnished unmounted so purchasers can attach them according to individual requirements. Two assemblies will be available: (1) A cast carrying handle, plus parts, for smaller instruments such as meters and gages; (2) two locker-type carrying handles, with feet and necessary assembly parts, for heavier potentiometer types, including electronic instruments. Brown Instrument Company, Philadelphia.

Nonpetroleum Lubricant

A new lubricant for internal-combustion engines, reported to offer advantages over mineral oil, particularly for cold weather use, is now being produced in commercial quantities. It is stated to have properties quite different in many respects from oils derived from petroleum.

The lubricant can be manufactured to any desired viscosity and is wax-free. Pourpoints vary from −30 to −80°F. Flash points range from 300°F. up. The new materials have densities approximating that of water. Carbon residue values are less than 0.01 per cent, regardless of viscosity. The lubricant is characterized by low change of


Pre-tested for Performance
DARNELL
CASTERS
DARNELL CORP. LTD. 60 WALKER ST. NEW YORK N.Y.
LONG BEACH CALIFORNIA 36 N. CLINTON CHICAGO ILL.

Announcement of Reprinting R. T. P. Translations

Some of the British Ministry of Aircraft Production R. T. P. translations, listed regularly in the ***Aeronautical Engineering Review,*** are now available in reprinted form. Individual copies or yearly subscriptions may be obtained from the Durand Reprinting Committee, c/o Aeronautics Department, California Institute of Technology, Pasadena 4, Calif. At present copies are obtainable at $0.05 per page. Since the cost is figured as a function of the number of subscriptions received, an additional 23 subscriptions will allow a reduction to $0.03 per page. Yearly subscriptions are computed on a guaranteed maximum of 2,000 pages per year. Subscribers entering an order at $0.05 per page will receive reprints immediately, plus a credit if the lower price is attained. Orders at $0.03 per page may be submitted but will not be filled until sufficient subscriptions have been received to assure this price. If the lower price is not possible these orders will be considered void.

On page 105* of this issue are listed those R. T. P.'s selected for reprinting because of their aeronautical interest.

* Please see footnote on this page.

viscosity with change in temperature, having viscosity indexes in the range of 140 to 160.

The new lubricant contains no petroleum oils. Its use in internal-combustion engines has been studied for several years in a large number of vehicles which have covered a total of over 1,500,000 road-miles. Large quantities are being used in military equipment. It is stated that these new lubricants practically eliminate sludge and varnish formation in the engine. Wear of the moving parts is comparable with the wear experienced with ordinary mineral oils. Ease of starting in cold weather is claimed to be a particular advantage.

The compounds are manufactured in two types, water soluble and water insoluble. The latter type is used for lubricating internal-combustion engines. Applications include lubrication of refrigerating machines and all kinds of machinery operated under conditions of low temperature or where a nonsludging oil is required, and as hydraulic fluids, textile lubricants, plasticizers, in leather-treating compounds, wire-drawing lubricants, and heat-transfer liquids. Greases having unusual high- and low-temperature properties have been prepared from these lubricants. Carbide and Carbon Chemicals Corporation, Unit of Union Carbide and Carbon Corporation.

Drip Pan for Leaking Oil and Grease

Servo-Unit drip pans are intended to prevent the floors of planes from becoming covered with dripping oil and to provide a means of visual inspection for the instant location of leaks in the hydraulic reservoir or the accumulator. Made of Lumarith cellulose acetate sheet-stock, the pans are light in weight, sturdy, and easily cleaned because they are impervious to the effects of oil and grease.

Drops of oil show up instantly on the clear transparent surface of the pan, revealing the presence of leaks that should be repaired at the earliest possible moment. A nozzle fixture at the end permits a hose connection to carry the oil outside the plane. Celanese Plastics Corporation.

Hardness Tester

A new hardness tester is designed especially for large or cumbersome parts. This tester also gives a true Rockwell reading, using either a diamond or steel ball penetrator supplied as standard equipment with the machine. The outstanding feature of the new model is its capacity. It can handle parts ranging in size from $^1/_2$ in. to 26 in.

Provision is made for raising or lowering the table by means of a hand crank. Position of the capstan, mounted on the side of the machine, may be correspondingly adjusted in relation to the table height. Heavy parts are loaded onto a roller-bearing carriage on the table, providing an easy method of positioning.

Readings are taken exactly as with the ordinary Rockwell tester. By means of the capstan the indicator is set at zero on the minor loads. The major load weight is released and a direct hardness reading is taken from the indicator. Clark Instrument, Inc., Dearborn, Mich.

Military Counterpart of Model 37

A troop-carrier land-based airplane, designated XC-99, is being constructed by Consolidated Vultee Aircraft Corporation for the Army Air Forces. The long-range, high-speed transport is the military counterpart of the recently announced Model 37, a 204-passenger civilian air liner. The XC-99 has a wing span of 230 ft., a length of 183 ft., and is powered by six pusher-type engines. It is a midwing, land-based transport, equipped with a tricycle landing gear.

Because of its capacity, the new plane may be used as a heavy cargo or hospital plane, as well as a troop carrier. It will be readily convertible for any of these operations. As a cargo plane, it will carry a pay load of 100,000 lbs. over a distance of 1,500 miles. Loaded with 19,000 gal. of fuel, it will have a range of approximately 8,000 miles with a reduced pay load. The 183-ft. aluminum-alloy fuselage is completely doubled-decked, with two large ramps utilized in the bottom of the lower section for loading. Equipment includes monorails and electrically operated hoists to facilitate loading throughout the upper and lower decks.

The fuselage of the XC-99 is being made in two sections while the 230-ft. wing is being built in four sections. Consolidated Vultee Aircraft Corporation.

Model 110 Postwar Passenger Transport

A 30-passenger Consolidated Vultee postwar transport airplane is designated as the Model 110. The domestic commercial transport will be a low-wing, twin-engined monoplane with a cruising speed of 275 m.p.h.

Passengers will enter the plane by means of a retractable stairway located beneath the tail. At the head of the stairs will be luggage racks and a full-height coatroom. Individually adjustable polaroid windows to reduce glare, spun glass insulation to keep out engine noises, and adjustable head rests for the custom-designed seats are among innovations planned for the comfort and relaxation of passengers. Cabins will be finished in restful colors. In addition, the plane's tricycle landing gear leaves the plane floor level when it is parked or taxiing.

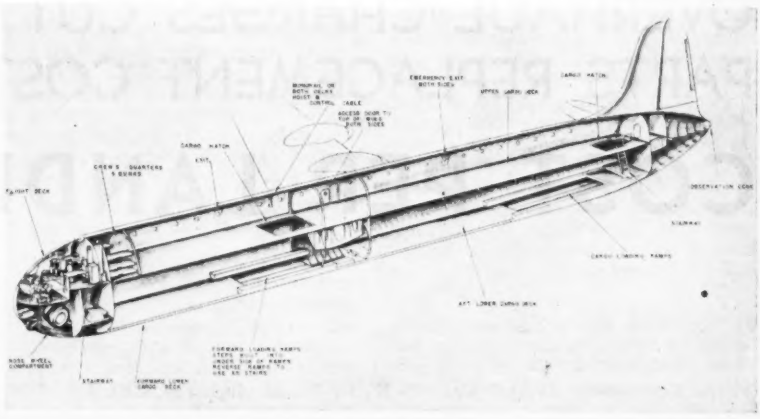
The transport will carry an 8,000-lb. pay load of passengers, mail, express, and baggage. Gross weight is 32,300 lbs. The maximum speed is more than 300 m.p.h. Its circular fuselage is 71 ft. long and the wing span is 91 ft. The tricycle landing gear will have dual wheels and tires.

Two Pratt & Whitney engines, each developing 2,100 hp., will power the Model 110. These will be equipped with four-bladed reversible-pitch propellers, which facilitate braking.

Other specifications are as follows: weight empty, 20,680 lbs.; passengers, 30; wing area, 820 sq.ft.; wing loading, 39.4 lbs. per sq.ft.; stalling speed, 79 m.p.h.; maximum range at 265 m.p.h. with 6,600-lb. pay load, 850 miles; service ceiling, 29,100 ft.; operational ceiling on one engine, 16,100 ft.; required CAR runway length for take-off (sea level), 2,900 ft.; flaps, fowler type; propellers, four blades, 12 ft., 2 in. diameter reversible. Consolidated Vultee Aircraft Corporation.

Synthetic Plastic Adhesive for Sandwich Construction

Establishing strong, lasting laminations of metals, plastics, and woods in various combinations, Cordo Bond Adhesive No. 250 bonds quickly by baking at a glue-line temperature of 250°F. under a pressure of 50 lbs. per sq.in. Bonds are reported to show high resistance to water, mild acids and alkalis, oil, salt spray, and general weathering conditions. Shear strength of the bonds is up to 2,000 lbs. per sq.in. This adhesive is said to be suitable for lightweight, high-strength sandwich con-



Cutaway drawing of the Consolidated Vultee XC-99 troop transport, a military counterpart of the manufacturer's Model 37.

HAYES
AIRCRAFT
Wheels and Brakes

PROOF

where it counts...on the ground!

With aircraft wheels and brakes, it isn't the long distance flight records that test their "stuff"—they just go along for the landing. Take-offs and landings, particularly short flights and frequent stops, are the proving grounds.

After one of the country's largest air lines—whose planes average 3600 hours a year, with landings every sixty minutes—changed to Hayes Wheels and Hayes Heavy-Duty Expander Tube Brakes, they built up this annual brake record per plane:

OVERHAULS REDUCED FROM 5 to 2
OVERHAUL CHARGES CUT 48%
PARTS REPLACEMENT COSTS CUT 63%

COST PER LANDING -7¢

Engineering judgement is tested and vindicated in the

"CHANGE TO HAYES"

Western Representative: Airsupply Co., 5959 W. 3rd St., Los Angeles 36, Calif.

HAYES INDUSTRIES, INC. Home Office: JACKSON, MICHIGAN, U. S. A.

struction and other quantity-production bonding of most materials. Cordo Chemical Corporation, Norwalk, Conn.

V-Tab Allows Maximum Loading of Big Planes Without Considering Weight Distribution

The Curtiss V-Tab is a trim tab designed to allow maximum loading of transport and cargo aircraft without consideration of weight distribution. Adding only 10 lbs. to the total weight of the airplane, the new device is in operation on the C-46 military version of the Commando.

Maximum utilization of cargo and passenger space in the Commando is the function of the V-Tab, which does not affect the airplane's speed and which operates automatically. Pilots will not have to "trim ship" while passengers walk back and forth in the cabin, and air-line maintenance men will have to be concerned only about the total load of passengers and cargo, rather than figuring out distribution of weight by a complicated slide-rule procedure. It will not be necessary to shift cargo from one compartment to another at airports, nor to "ground" passengers when there are vacant seats, because of cargo loaded so that rearward seats may not be used. The device is seen as contributing to the early development of "flying club cars," since it permits the free movement of passengers during the flight. Curtiss-Wright Corporation.

Free Weight Jacking System

To permit safer and more efficient handling of large airplanes while on the ground, and especially during maintenance and overhaul, Douglas Aircraft Company has developed the "Free Weight Jacking System." It is a means of creating an air-borne attitude without changing the elevation of the airplane with respect to the ground and to the work platforms surrounding it, yet freeing the landing gear for retraction checkout, removal, or routine servicing.

The aircraft is towed into the work dock and is positioned approximately by means of guide lines and wheel stops. Rigid shoring columns with adjustable jack points index with the plane's jack pads. The columns are dimensioned to clear the understructure of the plane as it moves in and out of the dock. The jack points are adjusted to snub the jack pads and then are made secure by means of a locknut on the threaded adjusting shaft.

Located under each landing gear and flush with the concrete are hydraulically operated platforms that are retractable to the distance necessary to permit the gear to hang free with oleo extended and tire deflection relieved. These platforms can also extend a limited distance upward. Should the shock-strut pressures be low when the plane is positioned in the dock, a static altitude can be attained before the jack points are adjusted, thus assuring a level plane. The extension travel will assist in removing and replacing a complete gear assembly when used in conjunction with a gear-handling fixture. The full travel of the platform can be used for exercising the oleo, adjusting microswitches, checking nose-wheel steering mechanism, as well as affording an effortless means of removing wheels and servicing the brakes.

Hydraulic and electrical weighing devices may be used between the shoring columns and jack pads. The plane can then be weighed with the gear retracted, which places the center of gravity in its true flight location.

To assure safety, the gear platforms will automatically lock in ground-level position so that hydraulic pressure failure will not cause the platforms to submerge before the shoring posts are engaged. The platforms, powered from a center power unit, are individually controlled by conveniently located deadman level control valves, which afford accurate control and minute adjustments. Douglas Aircraft Company, Inc.

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.

Pocket Compass Combination Unit

A combined pocket compass and match case, molded of plastic, is recommended by the manufacturer for aircrew members. Easily carried in life-vest pockets, the unit weighs less than 2 oz. and measures 3 in. high and 1 in. in diameter. Dial-type and liquid-filled, the compass is reported to operate accurately. It is sealed inside the cap of the case, and readings are made through two windows of transparent Tenite. At the top are the sight and a white luminous arrow that points North. The exact direction the bearer faces is indicated through a side window, captioned in raised letters: "You are looking." The match compartment, onto which the compass section screws, holds two layers of waterproof half-size matches. Requirements for withstanding extremes of temperature, rough treatment, and immersion in sea water are met by the unit. Eastman Kodak Company, New York.

Motor-Driven Dry Air Pump

The Eclipse Type 1511 motor-driven, explosion-proof dry air pump requires no lubrication and is designed to provide air pressure or suction for various applications requiring its characteristics. The pump provides a theoretic airflow of 4.1 cu.ft. per min. at 10,000 r.p.m. and is driven by an integral 0.2-hp., 27.5-volt d.c., explosion-proof motor. The rated capacity is 0.018 lb. per min. airflow at 11.1 in. Hg. Abs. inlet pressure, maintaining 31 in. Hg. Abs. discharge pressure.

Maximum operating characteristics any one of which should not be exceeded are as follows: current draw, 15 amp.; pressure differential, 20 in. Hg.; discharge temperature, 300°F.; minimum flow, 0.01 lb. per min.

New construction eliminates oil filters, separators, or accumulators in the system and provides air that is stated to be free of oil contamination. The oil-free nature of the discharge eliminates the explosion hazard in applications where electrical discharges occur. Since the pump requires no lubrication, it can be mounted near its supplementary equipment or in inaccessible places, such as horizontal stabilizers, dorsal fins, wings, etc. Automatic electrical overload protection is incorporated and provisions are made for wiring connections through electrical connector fitting AN-3102-16-11P.

The pump is a rotary, single-vane type, the vane being held against the rotor by pressure exerted through dual helical springs. The finned-rotor housing design dissipates heat rapidly. The unit weighs 4.75 lbs. and measures $8^{21}/_{32}$ in. long by $3^{17}/_{32}$ in. diameter. Eclipse-Pioneer Division, Bendix Aviation Corporation.

Flasher-Interrupter

A new flasher-interrupter unit is composed of a miniature but heavy-duty relay, an electrothermal timing device, and a noninductive resistor unit. All components are incorporated in a single assembly which weighs only 7 oz. Four studs are provided for mounting on panel, bracket, shelf, etc., with Elastic Stop units providing immunity to shock and vibration. The unit is expressly designed to withstand acceleration of 10*g* in aircraft applications. The flasher-interrupter is normally furnished in open design, but any required enclosure can be supplied, including hermetically sealed or pressurized types.

Interruptions can be controlled through a range of from 60 to 80 per min. by varying the current through the thermal unit. Operating voltages include all standard a.c. and d.c. ranges and frequencies. Other voltages and frequencies are supplied on special order. Normal actuating current is approximately 200 microamperes. Double-pole, double-throw ratings are 15 amp. (noninductive) at 32 volts d.c. or 116 volts a.c.; 5 amp. (noninductive) to 220 volts a.c. Single-pole, double-throw, double-break ratings are 25 amp. (noninductive) at 32 volts d.c. or 115 volts a.c.; 7.5 amp. (noninductive) to 220 volts a.c.

Applications for this flasher device are many, including aircraft-identification lighting. Its use is suggested wherever a predetermined number of interruptions are desired in any electrical or electronic circuit. Electronic Testing Laboratories, Newark, N.J.

AiResearch Announces the CABIN PRESSURE REGULATOR OF THE FUTURE

TOMORROW'S REGULATOR READY NOW

Weight 7½ lbs.
Height 10⅛"

THE END RESULT OF 10,000 BUILT FOR A.A.F. PLANES

Today AiResearch is manufacturing the Model 1 cabin pressure regulator for A.A.F. combat planes. It weighs less than eleven pounds. It is fully automatic and operates entirely on airflow without outside source of power. It is the *only* regulator ever put on a production line basis, and it has a record of no mechanical failures during operational or combat flight. This achievement is the result of pioneering research for seven years. No other concern has built up such "know how."

Tomorrow's Regulator—the AiResearch Model 21 is now available to all airplane manufacturers. Now ready for commercial use, it is the result of experience gained through thousands of hours in wartime operation. It is *still* simpler in construction, easier to maintain and revolutionary in its performance. Weighing *only 7½ pounds total,* it will provide airline passengers with any desired pressurized cabin condition in absolute safety. Devices for heating, cooling and air conditioning are included as a package.

Tomorrow's Cabin Pressure Regulator

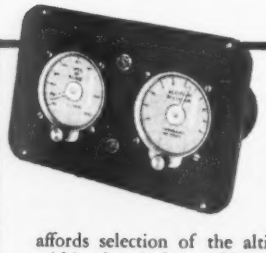
The new AiResearch cabin pressure regulator makes possible an almost unlimited selection of cabin pressure schedules within the range of commercial flying.

For flights between the airports of equivalent altitude level, the regulator will maintain an "airport" pressure within the airplane cabin throughout the trip.

For flights between airports at different altitude levels, it will regulate cabin pressure at a gradual rate of change to the pressure of the atmosphere at the point of landing.

Hence, it will no longer be necessary to make a spiral ascent or descent over the airport in order to keep the rate of cabin pressure change to a value which will afford passenger comfort . . . thus making a great saving in time and fuel.

For more complete information, write the AiResearch Manufacturing Company, Los Angeles or Phoenix.



The AiResearch Model 21 regulator is equipped with an electrically operated cabin altitude selector and rate of change control—the two being synchronized.

The cabin altitude selector (right hand knob on the box) affords selection of the altitude pressure to be maintained within the airplane cabin.

When the change is completed, the regulator "levels off" and maintains a constant pressure within the cabin until reset. In this way the pressure within the airplane can be increased or decreased at any time during flight at a rate low enough to provide ample passenger comfort.

The rate of change control provides a means of regulating the speed with which the change in altitude takes place.

AiResearch — manufacturers of AIR CONTROL equipment
Cabin Pressure Regulating Systems • Engine Oil Cooling Systems
Supercharger Aftercooling Systems • Temperature Control Systems
Engine Intercooling Systems • Automatic Exit Flap Control Systems

AiResearch
DIVISION OF
THE GARRETT CORPORATION

Electric Synchronizer for Air-Borne Guns

Gunfire through airplane propellers is now being timed through the use of an electric gun synchronizer. This synchronizer system, designated by the Navy as the Mark 3, times the firing of three M-2 0.50-cal. aircraft machine guns and provides passage for their bullets through a three-bladed propeller rotating at speeds of from 800 to 1,500 r.p.m.

Supplanting the mechanical synchronizer, the electrical system is said to be a definite advance for several reasons. Unlike the mechanical device, the Fairchild Mark 3 unit permits guns to be mounted in positions more remote from the motor, firing anywhere within the arc of the propeller. On the electrical system, there is no limit to the number of take-offs, although there is a limit to the number of guns which can be fired successfully through the blades of a propeller. Electrically, it is possible to synchronize with propellers having three or four blades. Weight and bulk are cut to a minimum with the electric system, and adjusting the synchronizer for operation is reduced from hours to minutes.

The electrical synchronizer system consists of one timer unit, one control box, and three motors, one for each gun. A feature of the instrument is the trigger-motor armature which, while weighing only $2^1/_4$ oz., is tough enough to exert a 55-lb. punch and take a 110-lb. recoil 72 times per sec. Engineering, operational, and metallurgic information about the system is available. Fairchild Camera and Instrument Corporation.

New French "Personal" Airplane

It is announced that a new private plane will soon be manufactured by French factories. With a reported cruising speed of about 140 m.p.h. and an approximate radius of 713 miles, the Sucio is designed to meet requirements for an easily operated and not-too-expensive civilian plane. It is expected to have a convertible and roomy interior, making the plane adaptable for ambulance service. The French Press and Information Service, New York.

"Baseball" Parachute Used by Armed Forces

Called the "baseball" parachute, a new type of parachute in use by the armed forces is reported to eliminate dangerous oscillation in descent. Unlike the standard parachute, which is made in the form of a flat circle and is distorted into a parabolic shape when inflated by the load on its shroud lines, the "baseball" parachute is constructed as a perfect hemisphere. It is made of sections of material cut in the form of figure 8's and then sewn together in the manner of a baseball cover. The resulting hemispherical form is said to eliminate oscillation.

Until now application of the "baseball" parachute has been confined to special operations requiring great precision, such as in B-29 mine-laying operations carried out in Japanese interisland shipping lanes, harbors, and anchorage inlets; the aerial delivery of delicate radar equipment and other supplies; and the dropping of portable lofts containing carrier pigeons. However, it is stated that tests completed by the Royal Canadian Air Force, as well as by the U.S. Army and Navy, have demonstrated that the new parachute, aside from eliminating oscillation, may be launched safely from planes traveling at much higher speed than is possible with the old-style parachutes. This is because the initial shock of opening is equally distributed over the entire surface of the parachute, being eased by the function of a floating cord in the hem of the parachute which acts as a pneumatic shock absorber. The danger of tears or breakage in the chute is minimized and the opening shock to the cargo dropped is far lighter.

The greater efficiency of the "baseball" parachute permits the use of noncritical materials, such as ordinary rayon, paper, or cotton sheeting in its construction, except where packing space or storage limitations require the use of Nylon. General Textile Mills, Inc.

Miller Attachment to Convert Lathe into Milling Machine

An improved miller is designed to convert a lathe into a combination machine that does the same precision work as a milling machine. This miller is an attachment that fits the ways of the lathe. Its operation is identical with that of a standard milling machine, except that the spindle is moved into position to engage the work, rather than the work being lifted to engage the spindle.

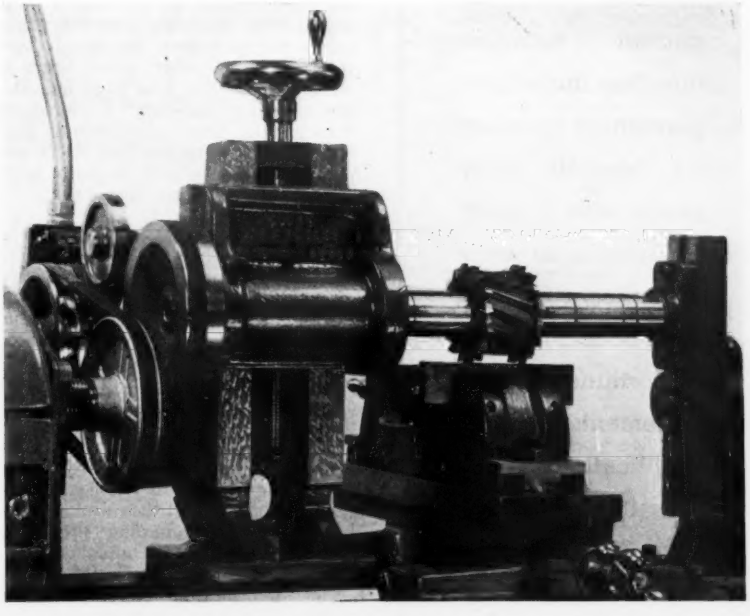
In addition, the miller almost doubles the swing of a small lathe. Costing only a fraction as much as a standard miller, this device is credited with performing practically any milling operation, such as gear cutting, slitting, gang-milling, cutting "T" slots in castings, cutting keyways in shafts, etc. Globe Products Manufacturing Company, Los Angeles.

Air Pressure Used to Measure Force

The Thrustorq is being used in engine-testing laboratories and factories to determine and record the thrust and torque of conventional airplane and automobile engines. A jet-engine manufacturer is using the instrument to measure the thrust of a new engine.

The basic part of the instrument is a flexible diaphragm that forms one face of an airtight chamber. Compressed air is admitted to this chamber through a poppet-type pilot valve. The force to be measured is applied to the outside of the diaphragm and is opposed by internal pressure. As the force increases, the pilot valve is opened and admits more air to balance the increased force. As the force decreases, air is exhausted until the external force and internal pressure are equal. Thus the air pressure within the chamber provides a direct measure of the externally applied force. The response of the instrument is practically instantaneous because the diaphragm movement necessary to operate the pilot valve is extremely small. Because the force is measured by air pressure, the instrument permits remote reading on any number of manometers, pressure gages, or recording devices.

Since the Thrustorq will function in any position it has been adopted by a manufacturer to measure the torque of vertical helicopter engines. Because



The Globe miller attachment for converting a lathe into a milling machine.

of its compactness and the fact that it requires almost no deflection to provide a reading of force, the unit can be used to analyze many structural stress and strain problems. Once installed, the instrument needs no attendant, and with a pressure recording device in the system, a continuous record can be had even at remote distance. Its construction permits it to be used under conditions where dust and dirt and cramped quarters previously had precluded the making of measurements. Hagan Corporation, Pittsburgh.

Inspection Process for Rocket Fuel

An improved method of examining rocket-powder grains by using high-frequency sound waves has been developed by research engineers and is expected to effect a saving of approximately $5,500,000 a year to the nation's rocket-powder program in materials and an appreciable saving in man-hours.

Supersonic waves of very high frequency generated by a crystal connected to a specially designed electronic circuit are passed through a rocket-powder grain. These grains are from 5 in. to 5 ft. long. If the grain has a flaw, a minute airspace under the surface, a certain percentage of supersonic sound waves will be deflected from a known course. This deflection is recorded on a meter that is connected to a receiving crystal. It is necessary to use sound waves with a frequency much higher than 15,000 cycles in the examination of rocket powder to reveal flaws. Before the new inspection method was developed, large X-ray pictures were taken of each powder grain. However, the output of rocket powder increased so rapidly that in March, 1944, it became apparent that there would not be enough X-ray film produced in this country to supply the demand when production reached its peak.

The supersonic method reduces the number of operations required to inspect a rocket-powder grain, is much less expensive to use, and is more sensitive in detecting flaws than the previous method. The amount of X-ray film used will be cut 90 per cent. The Brush Development Company, Cleveland, was selected to build the supersonic generating and receiving equipment. The equipment is in use at Hercules-operated ordnance plants manufacturing rocket powder. Hercules Powder Company.

New Diaphragm Cloth

A specially processed cotton cloth, designed for diaphragm use, as in fuel pumps, has been developed. The new product is said to have excellent bursting and tearing strengths, retains its flexibility, and offers almost instantaneous recovery over a wide range of operating temperatures. Irvington Varnish & Insulator Company, Irvington, N.J.

Oil Filter Kit for Airplane-Engine Test Overhaul

Difficulties with gravity oil feed in overhauling airplane engines on the test stand are overcome by means of a new-type oil filter kit. The new kit provides the required oil pressure and, by filtering the oil, eliminates dirt in the engine line and the consequent possibility of bearing failure. The kit includes a 3-hp. engine, filter assembly, and two gages. Oil is pumped from the weigh tank through the assembly, which filters to six microns. The first gage indicates the pressure necessary to force oil through the filter; the second gage shows the drop across the filters and pressure to the engine oil-pump inlet. Jacobson & Company, New York.

Surface-Protection for Gages

A new development in the protection of gaging surfaces of plug, thread, and special gages is called Jan-Seal. It consists of a plastic coating applied to the gage by dipping.

By forming a "tailor-fitted" cover over the gaging surface, Jan-Seal is said to keep the tool in perfect condition during shipment and storage. It is easily removed and replaced after use, eliminating the necessity of coating the gage with grease and then wiping it off. In addition to affording protection against rust and corrosion, the coating is credited with protecting the gage against damage from dropping or being struck. Jansson Gage Company, Detroit.

Jarvis VJ-21 Light Airplane

A cruising speed of 110 m.p.h. at 65 hp., a top speed of 135 m.p.h., a landing speed of 40 m.p.h., and a cruising range of 400 miles . . . these are the claims of the designer for the new Jarvis VJ-21, a pusher-type light plane now under development. The plane is a two-passenger (side by side) craft of all-metal monocoque construction. According to the designer, the VJ-21 will land at 40 m.p.h. on a rough field and cannot ground-loop because of its single main-wheel landing gear and 3-in. steel nose skid. Two manually retractable small wing wheels swing down to support the wings for taxiing. The 110 m.p.h. cruising speed and efficiency are said to be based on sailplane principles. Clean fuselage lines and a full cantilever wing with high aspect ratio provide good speed characteristics with low power. The partly enclosed single landing wheel eliminates the drag of the conventional landing gear with long struts. Wings are long and narrow, while the fuselage is round. The wing span is 45 ft., with a 5-ft. chord at the fuselage tapering to 2 ft. at the tips. The design is stated to lend itself to amphibian or seaplane adaptation.

The propellerless nose affords full vision in all directions, a windshield free of grease and oil spatter, less vibration and engine noise, and extra leg room. Flaps are provided for low landing speed and spoilers eliminate the need of sideslipping and other such causes of losing altitude in landing. The single wheel allows a level take-off and landing and is equipped with a single brake, which can be applied without tendency to ground-loop or turn over. The tail wheel is steerable and full-swiveling for easy taxiing. Price has not yet been determined but is expected to be around $2,000. Jarvis Manufacturing Company, Glendale, Calif.

Stratoscope Anticollision System

Development of an anticollision system to prevent accidents between aircraft and tall buildings or mountain peaks has been disclosed. The system is known as the Stratoscope. It is a panoramic development in which the manufacturer utilized years of experience in the invention, application, and production of precision aerial navigation instruments. The Stratoscope system is not radar in principle but embodies proved fundamentals of radio operation and the use of a sensitive aneroid diaphragm altimeter similar in type to those that are standard navigational equipment on present aircraft. It is said that the equipment for installation in planes would be light in weight and moderately inexpensive and that the equipment for installation on high buildings and other obstructions also would not be too costly or difficult to install. Kollsman Instrument Division of Square D Company.

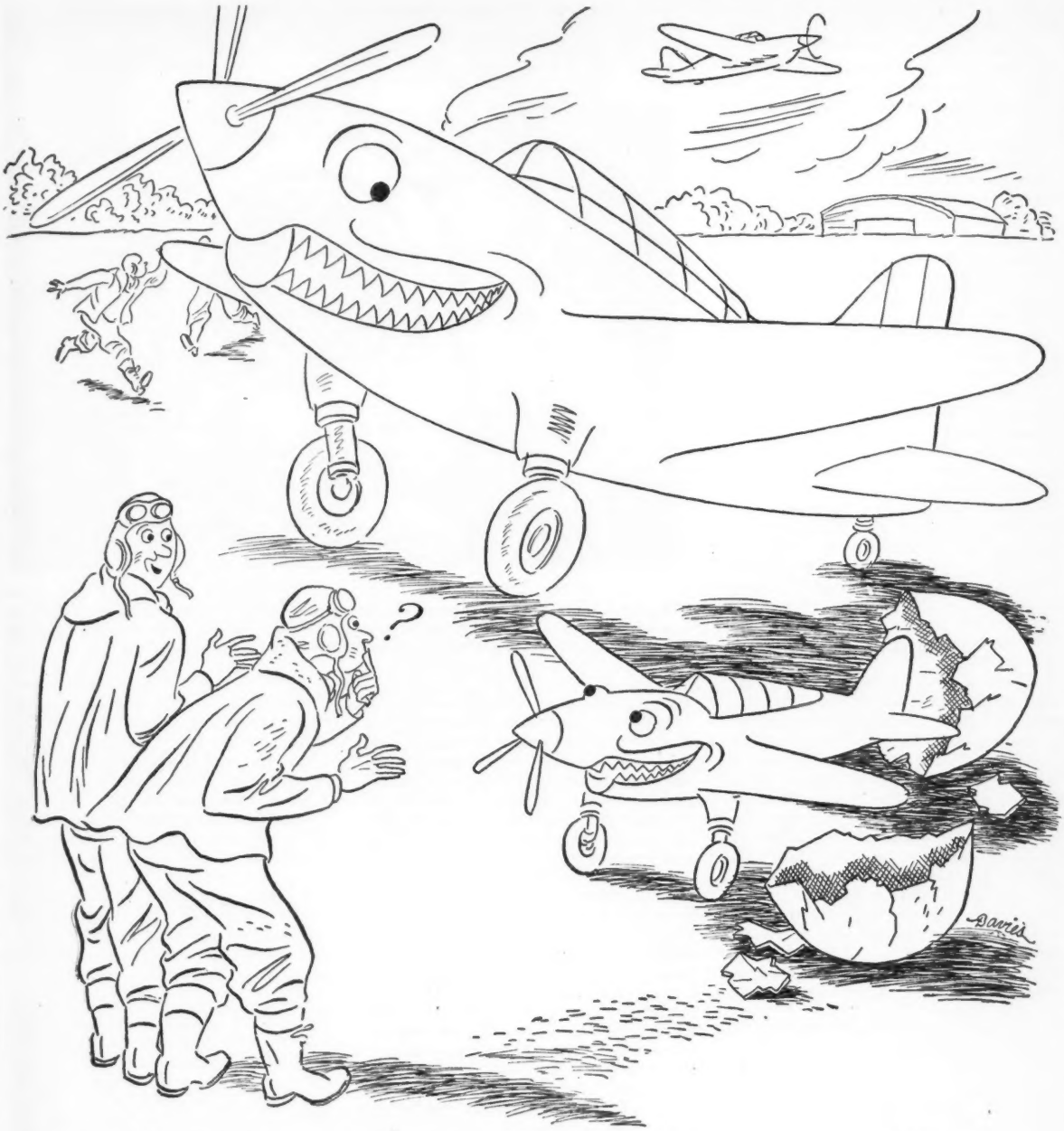
Rotary Solenoid

Ledex, a rotary solenoid developed for use in the mechanisms of bomb releases.

UNUSUAL OPPORTUNITY

FOR AIRCRAFT ENGINEERS

Southern California aircraft manufacturer has immediate, permanent openings for aircraft engineers with 5 years' experience in aerodynamics, structural design and C.A.A. airworthiness requirements. Airmail qualifications and recent photo to P. O. Box 29, Burbank, California.



"Even if I reported this, the CO wouldn't believe it!"

So many new aviation ideas have been hatched during wartime that it is easy for the general public to slip into the belief that major aviation progress is possible only during wars.

Nothing could be further from the truth. Many developments hailed as wartime discoveries were in practical use long before the beginning of hostilities. The needs of war served to speed their *production*. Furthermore, the emphasis on military aviation has tended to sidetrack the development of commercial and private aircraft. This lag must be made up by strengthening of research programs, rather than their abandonment.

For example, engines must be developed to realize the full possibilities of future aviation fuels from both performance and *economy* standpoints. Aviation gasoline has already burst through its "ceiling" of 100 octane. New refining methods and the use of Ethyl fluid have provided new fuels so high in antiknock quality that some means other than the "octane" scale will be required to express their ratings.

Post-war research workers, unhampered by the specialized requirements of military planes and fuels, may well make the years *after* the war the truly great era of aviation progress.

Ethyl Corporation

CHRYSLER BUILDING, NEW YORK CITY

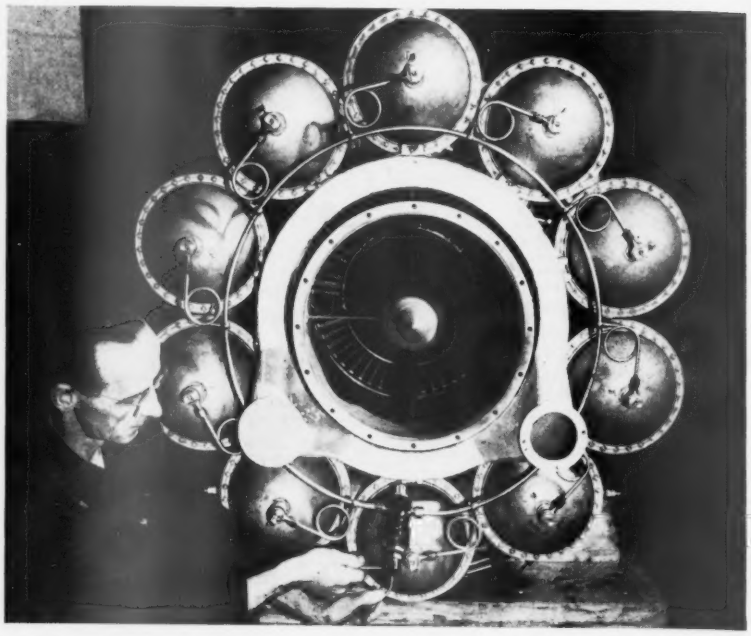
Manufacturers of Ethyl fluid, used by oil companies to improve the antiknock quality of aviation and motor gasolines.

is said to be applicable to many controls in the aviation field. This rotary solenoid is used in the bomb shackles of Mustang fighter planes built during the last year and a half and has been installed in other planes and various military installations.

The bomb-release solenoid is smaller in diameter than a man's pocket watch and about twice as thick. For a given amount of material and current, it is credited with delivering many times the power of conventional solenoids. When the magnet is energized by an electric current, a rotary motion is imparted to the upper member of the solenoid. The torsional power of the rotating member is in excess of 4 in.lbs.

In the bomb-release application, a lever rests upon a pin $^1/_4$ in. from the axis of the solenoid, where the force is more than 16 lbs. The instant an electrical contact is made, the pin is turned through a 45° arc, allowing the lever to drop, thereby actuating the mechanism of the bomb release.

Besides saving space, the Ledex solenoid is stated to meet Government requirements of immunity to accidental operation through shock. It can be manufactured in a wide range of capacities. George H. Leland, Dayton, Ohio.



Photograph Courtesy General Electric Company

Rear view of the G-E jet engine of the first type produced for the Army Air Forces. Its external appearance is similar to the engine of the P-80. The ring of metal tubes around the central power section constitutes the combustion chambers.

Details of the P-80

The jet-propelled P-80 Shooting Star was exhibited at Washington, Dayton, Burbank, Los Angeles, and elsewhere as a part of the observance of the 38th birthday of the Army Air Forces, on August 1. Photographs of the craft, also released from the secrecy that has surrounded it since its first flight in January, 1944, disclosed droppable fuel tanks mounted on inner shackles and faired into the extreme tips of the wings. First jet fighter accepted for combat by the Army Air Forces, the P-80 is designed to intercept and attack enemy aircraft in high-altitude flight or carry out any war tasks now assigned to conventional fighters. Its ceiling is well above 45,000 ft.

The Shooting Star has a wing span of 38 ft. $10^1/_2$ in., an overall length of 34 ft. 6 in., and a height of 11 ft. 4 in. Total weight empty is approximately 8,000 lbs. Gross take-off weight with maximum fuel capacity is about 14,000 lbs. which is 4,000 lbs. lighter than the gross weight of the P-38 Lightning. The centerline of the laminar-flow, low wing is 2 in. behind the midpoint of the fuselage. The flat wing tapers at both leading and trailing edges. Control surfaces total only 31.6 sq.ft., compared with 70.3 sq.ft. on the Lockheed P-38. With no propeller slipstream or torque to overcome, rudder tabs are eliminated. The cockpit, topped by a plastic bubble canopy and located forward of the wing in the long slender nose, gives the pilot excellent vision for every maneuver. It is pressurized from the G-E jet to give the pilot comfort in the substratosphere.

The engine is mounted within the fuselage directly behind the cockpit. The G-E jet actually has one moving part—an impeller and turbine connected by a shaft. The turbine and impeller spin at more than 10,000 r.p.m. The impeller forces air into the combustion chambers from the two intakes molded into the fuselage at the wing roots. Kerosene injected into the combustion chamber burns fiercely in the compressed air. The engine has a self-contained lubricating system that eliminates oil coolers, piping, and tanks.

Engine output is rated in pounds of thrust. The General Electric superjet develops a maximum thrust several times more powerful than the reciprocating engine used on the P-38 Lightning. Thrust increases as jet velocity and air-mass flow increase. The only engine control is the throttle. The tachometer that shows the revolutions per minute of the turbine compressor is the principal instrument necessary to determine thrust output.

The airplane is extremely maneuverable. Even at great speeds Lockheed-designed hydraulic aileron boost and balanced empennage controls give the plane a maneuverability limited only by the pilot's ability to withstand the forces of tight turns and pull-outs. Lockheed-developed fuselage flaps are arranged to form an unbroken line with the wing flaps across the plane's undersurface when extended. Since there is no propeller to create air drag, the fuselage flaps help slow the Shooting Star down for landings at conventional speeds. These flaps beneath the fuselage may be operated together with or independently of the conventional split-type wing flaps.

The six machine guns merge into the lower part of the nose, a position that eliminates possibility of gun flash blinding the pilot. The gun sight is an electrical gyro-lead computing type with a reflex optical system. The six ammunition boxes each are upside down from their position in the P-38 Lightning—above the guns that they serve. Magazines and guns can be removed and replaced in less than 15 min. without use of platforms or ladders. A gun camera is located in a slight bulge of the right-hand air-intake duct. Protection for the pilot is provided by an armor glass windshield, steel armor plate on the upper forward side of the front bulkhead and back of the pilot's seat and head, and dural plate aft of the front bulkhead.

Both nose and aft fuselage are secured by quick-action tension fittings and may be removed for service and maintenance within a matter of minutes. With the aft fuselage, including the nozzle, removed by detaching three fittings and the tail-pipe clamp, the G-E jet engine is accessible for maintenance and may be run up without removing it from its position in the fuselage. A complete engine change may be finished in less than 20 min. The nose section, aside from armament or photographic equipment, contains compartments for oxygen, radio equipment, and the adjustable landing light. In the center fuselage section are the cockpit, fuel tanks, and power plant. Space beneath the cockpit holds the hydraulic, fuel, and radio equipment.

The aluminum-alloy wing of full cantilever design is built in one unit containing retractable sway braces for carrying the droppable fuel tanks or bombs on the wing-tip shackles. Ailerons are conventional. The main tricycle landing gear, operated hydraulically, folds inboard into the wing.

A smooth "piano" finish that enhances the harmony of the aerodynamic lines adds greatly to the plane's overall speed and performance. To attain this surface, rivets are cut and surface-ground. A zinc chromate primer is applied. All butt joints are cement-filled, and flexible joints are covered with organdy mesh tape. A surfacer is applied in preparation for the paint, which is baked on in special ovens large enough to hold the entire plane. Light sanding and buffing follow. A specially developed wax is then sprayed on and polished. Lockheed Aircraft Corporation.

Tool for Aligning Parts of Electrical Clamp Assembly

A tool has been developed for holding parts together in perfect alignment during the assembly of electrical clamps. The tool eliminates the loss of time caused by the need to realign and retighten crooked clamps and, in addition, makes possible the use of a compressed-air nut runner for faster assembly.

The base of the tool, made of fiberboard, is placed in a vise when the tool is in operation. The parts are held by a slot in the base and a series of three pins, while the fiber arm of the tool is held down on the clamp keeping constant pressure on the screw that joins the two parts. When the nut is turned, the head of the screw is automatically forced onto the "built-in" screw driver, holding it until the nut is tight.

It is stated that, with slight modifications, tools of this type could be made adaptable to assembling other types of clamps. The Glenn L. Martin Company.

Two-Piece Copper Brazing Assembly Method

A saving of 13 cents per part on standard cam followers is credited to the adoption of a two-piece copper brazing assembly method. Prior to this time the cam followers had been machined in one piece from solid steel bar stock.

Using the brazing method, the cylindric portion of the assembly is a piece of stock steel tubing, which is sized to the proper diameter for brazing and cut off in the screw machine. The rectangular flanged portion is blanked from strips of steel stock by a progressive die. The round hole in this rectangular piece through which the cylinder passes is blanked and sized to proper dimensions in the same operation.

For brazing, the cylindric portion is slipped into the hole in the flange after which the assembly is placed on a part holder and the rings of copper brazing are placed on each assembly at the joint. The parts holder is loaded with the assemblies and placed in an electric brazing furnace. During the brazing process the copper ring melts and creeps into the joint by capillary attraction, resulting in a strong, clean joint.

After brazing, manufacturing procedure to finish the parts is the same as in the former method. The two attaching holes are drilled and burred, the cam portion is profiled by milling, and the edge is hardened by induction heating.

It is reported that during tests the new-type followers were found to have strength beyond any previous design requirements. The Glenn L. Martin Company.

Improved Cargo-Handling System

By means of an improved cargo-handling system, it is reported that the latest cargo version of the Mars, with its new cargo doors and ample hull compartments, can be fully loaded in an hour's time, and unloaded in half an hour. Demanding no costly equipment, the plan, developed by the Naval Air Transport Service, permits maximum utilization of cargo space, while reducing to a minimum the time, clerical work, and man power needed for loading and unloading.

Load planning is the keynote, determining the handling of cargo from the moment of arrival at the warehouse to the time it is actually in the plane and until it reaches its final destination. Except for specially tagged, fragile items or bulky articles, individual handling of pieces has been eliminated. Regular cargo is segregated by destination, priority, and bulk and is stationed on the plane with regard for convenient access and balance factors.

Checking and segregation of cargo is performed in a warehouse adjacent to the flying-ship dock. Special nonstretch nets, with eyelets at the four corners, are spread on specially constructed, oblong wooden flats that constitute a replica of the airplane cargo deck. Cargo is loaded to a uniform height on the flats and is tightly netted by means of a rope run through the eyelets so that no movement of pieces occurs. Each flat has a number that is used for cargo-control purposes. When filled, each net is tagged by priority, destination, and a number corresponding to the flat. It has been estimated that only 2 hours is needed to check 30,000 lbs. of cargo, containing several thousand items. All essential information, including flat number, priority, destinations, weight, and location in the plane, is graphically listed on several standardized, simplified forms.

Mechanical shop mules and trailers, rather than trucks, are used to haul the netted cargo to the shipside. A cargo hoist built into the wing of the Mars picks up the nets and swings them into the main cargo compartment, leaving the flats behind. Three men, one working outside and two inside the plane, can easily load the entire craft. In the fore and aft compartments, where the cargo hoist does not extend, low-wheeled "skates," which are base equipment supplied with the plane, can be used for moving cargo to the desired location. Removing cargo from the "skates" is facilitated by three evenly spaced rings imbedded in the ceilings through which a block-and-tackle may be placed. Tie-down fittings and specially designed nonslip lashing equipment hold the nets in place during flight. The Glenn L. Martin Company.

Stop Device for Cutting Blades

Development of a metal adjustable stop that is used in conjunction with the cutting blades on a wire-stripping machine for removing the shielding from coaxial cables, is reported to have resulted in a considerable saving of scrap materials.

In the method formerly used the cable was placed in the cutting slot and the blades closed around the cable from the top and bottom until they cut through the insulation, which could then be stripped off at the end of the wire. The chief problem was that, since the cutting machine was used on many sizes of cables, the depths to which the blades were permitted to cut were more or less a matter of guesswork on the part of the operator. As a result, the cuts often were made too deep and the wire was sufficiently damaged so as to make it unfit for installation purposes.

The new stop fixtures are now attached at the side of both the bottom and top blades of the stripping machines. They are designed with convex ends so that the edges of the fixture when closed form a circle around the cable and prevent the blades from cutting any deeper than necessary into the insulation. By making them adjustable and in various sizes, many kinds and sizes of cables can be cut on the same machine, using the same machine blades.

Before the new stops were added, scrap material on smaller cables sometimes amounted to more than 50 per cent. Now the scrap loss is eliminated. In addition, they have resulted in a saving of approximately 1,500 man-hours per year in eliminating rework necessary before this time. Experiments are under way to determine whether the same idea, with changes and modifications, can be applied to other cutting processes. The Glenn L. Martin Company.

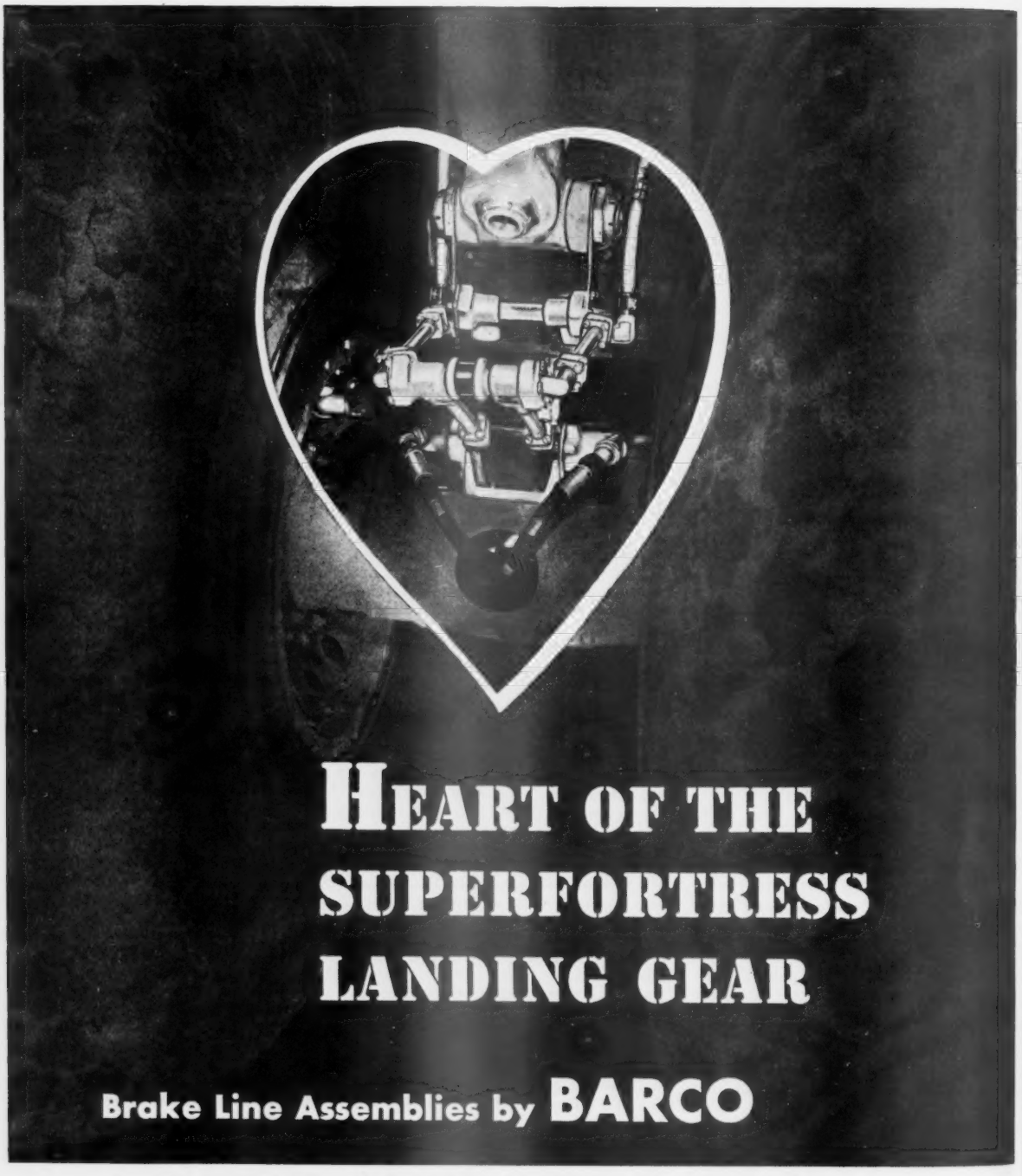
Free-Flowing Flux for Gas Welding

"Flo-Well" No. 1 is an improved free-flowing flux for gas welding of aluminum and aluminum alloys. It is used in gas welding of wrought, cast, or high-tensile aluminum and aluminum alloys of any size or shape. The maker states that it will not solidify or deteriorate and can be applied by inexperienced welders.

This flux is packaged in 1/4-lb. to 25-lb. glass containers to protect it from moisture. It may also be purchased in ton lots. A. K. Mauk, Pittsburgh.

P-51H

A new and speedier model of the P-51 Mustang is now being produced as the P-51H. Different from earlier models, the new Mustang was designed in response to a need for a fighter with greater range, more speed, and higher ceiling for the Pacific war. It also has



HEART OF THE SUPERFORTRESS LANDING GEAR

Brake Line Assemblies by BARCO

In recognition of the high standards maintained in Barco's inspection system, the factory has been recently awarded the "Approved Quality Rating Control" of the U.S. Army Air Forces.

BARCO

Manufacturing Company, Not Inc., *Aircraft Products Division*
1800 Winnemac Avenue, Chicago 40, Illinois

FLEXIBLE JOINTS

Not just a swivel joint . . . but a combination of a swivel and ball joint with rotary motion and responsive movement through every angle.

Free Enterprise—The Cornerstone of American Prosperity

"MOVE IN EVERY DIRECTION"

an increased strength of 10 per cent throughout, despite a 700-lb. reduction in overall weight.

In the P-51H, engineers are said to have boosted the Mustang's effective combat range 37 per cent without adding to its fuel load. Aerodynamically, the plane has been altered considerably, making the drag much lower and eliminating the need for greater fuel-carrying capacity. Speed has been increased to over 460 m.p.h., with a new wing section of the laminar-flow series among the improvements contributing to the increase.

Generating over 2,000 hp., the powerplant section in the P-51H is developed around a Packard-built Rolls-Royce V1650 engine, utilizing a fuel-injection pump and a new four-bladed propeller designed for higher engine horsepower. The added boost gives the Mustang efficient operation up to 42,000 ft. and a ratio of climb 26 per cent faster than the earlier model.

The engine mount is 40 per cent lighter, and much of the weight-saving was accomplished in this section. Lighter-weight alloys, material-saving installations, and advanced aerodynamic features account for the further reductions. Electrical controls are grouped centrally to reduce wiring, and the radio control panel has been simplified. An improved seat installation, better heating and ventilating systems, and other accommodations are designed to reduce pilot fatigue.

The P-51H is fitted to carry ten "Zero Rail" rockets under its wings. Racks to carry bombs weighing up to 1,000 lbs. or extra fuel tanks also are mounted under each wing. Although the plane retains the six 0.50-cal. machine guns of earlier Mustang models, improvements have been made in these installations to increase the reliability of the armament as well as to simplify service maintenance. North American Aviation, Inc.

Neoprene-Coated Fiberglas for Seats, Bunks, and Other Applications

Following tests of tear and tensile strength, dimensional stability, and general durability in use, Transcontinental & Western Air, Inc., has adopted a Neoprene-coated Fiberglas cloth as the supporting fabric for seats on its commercially operated planes and for crew bunks on its C-54 passenger and cargo planes. It has also developed a steering-gear dust boot of Neoprene-coated Fiberglas cloth.

The coated glass cloth was originally tried as a supporting fabric for seats on a number of Stratoliner planes, which were subsequently turned over to the Army and used as C-75 transports. These planes are now being returned to the air line and are being completely reoutfitted with seats in which the coated glass cloth is incorporated.

The steering gear unit, which is now protected by a coated glass cloth dust boot, is a plunger-like device. The protective boot, therefore, must contract and expand with the movements of the plunger. All-rubber boots, originally used, wore out rapidly under the severe operating conditions, including constant flexing. Experience with the coated glass cloth boots is reported to show that they give a minimum of 50 per cent more wear than the all-rubber boots. Owens-Corning Fiberglas Corporation, Toledo, Ohio.

Portable Workshops for Repair of Bomb and Computing Sights

Lightweight, collapsible workshops that can be transported by air and set up at advance bases are being employed by the Army Air Forces for the adjustment and repair of bomb sights and computing sights. Equipped with precision tools, the shops enable skilled A.A.F. mechanics to do the work on the spot, saving the time that would be required to send the instruments to rear bases.

Compressed glass fibers, treated with a resin and shaped into flexible boards, are employed as insulation to help assure the required control of temperature and humidity within the shops. It is reported that this inorganic Fiberglas insulation resists the attack of fungi encountered in Pacific war zones and is incombustible. Its light weight is an important factor in making practicable air transportation of the shops. Owens-Corning Fiberglas Corporation.

Device for Making Perspective Drawings

The Pomeroy Stereograph perspective-drawing machine produces a perspective view as stereoscopic pairs showing length, width, and depth or, if desired, as a single perspective drawing. With the device it is not necessary to use the ordinary equipment of the drawing board to find vanishing points. It is used also for solving problems in geometry and descriptive geometry. The makers state that the machine can produce three-dimensional graphs, create space curves, and, through its three-dimensional effects, also show the internal construction of complex mechanisms.

The instrument is constructed of duraluminum with high-carbon steel for the guides and rotating members. It is 32 in. long, $3^1/_4$ in. wide, and mounted between two drawing boards. At the top is a hairline point finder 20 in. long and at the bottom is the drawing straight-edge 20 in. long, by means of which the operator can make the perspective drawing. The two drawing boards are each 23 by 31 in., mounted on square metal tubing. Dowel pins provide a simple means for positioning these boards so that they can be removed with the drawing for additional work and replaced in the machine in exact register. The mechanism that moves the hairline in a predetermined arc over the plan and elevation drawings from which the points are to be transferred, and also the accompanying drawing straight-edge, is simple but is constructed so that it can be operated with accuracy.

Points obtained from orthographic projections of the object to be drawn can be transferred to the lower drawing board where the draftsman can produce perfect perspective drawing. After the first perspective drawing has been made, its stereo-component drawing can be produced quite simply by shifting the viewpoint the correct interpupillary distance. This change is accomplished by means of a simple adjustment. The component requires the transfer of points from the plan view only, in that the elevation is common to both eyes, and for this reason elevation points can be transferred at once from the previously made drawing.

The stereo-pairs that are produced are called Stereographs and can be viewed in any suitable stereoscopic viewer. They can also be copied photographically, enlarged, or reduced and can be projected for a large group of spectators in stereoscopic relief by means of polaroid or similar means for stereoscopic projection. Pomeroy Stereograph Company, Inc., Cleveland.

Aluminum Drill-Guide Pressure Foot

Used with hand motors in jig-template drilling, a new drill-guide pressure foot provides a means of utilizing steel template stock in place of heavy drill plates and bushings in production-line assembly drilling by indexing to standard-size holes in the template. Its construction also allows the use of standard-size tips, which can be quickly interchanged to provide various drill sizes. Templates can be duplicated quickly from master templates with the use of clips and fasteners and can be used as assembly jigs as well as drill templates.

The foot is also used as a substitute for slip bushings of various drill sizes to the same index hole. In stock drilling its spring loading holds work together, aiding in the elimination of burring of holes between sheets. The device is available with and without drill guides. Products Engineering Company, Beverly Hills, Calif.

Rust-Inhibiting Treatments for Metal Parts

Micronoil Riso is an acid-free or neutral oil, emulsifiable, which is added to 15 to 50 parts water as required by the nature of the parts to be treated. It is used at a temperature of 160°F. The metal parts are immersed in the bath until they reach the required heat and then are drained.

The manufacturer states that weather-exposure tests of aircraft parts were started in October, 1944, continuing through Michigan winter conditions until March, 1945, with no visible evidence of corrosion. Protective Coatings, Inc., Detroit.

Navy Helicopter Project

The XHRP-1 helicopter was designed at the direction of the Bureau of Aeronautics, specifically to fulfill Coast Guard and Navy air-sea rescue and transport service requirements. It is stated to be the first helicopter designed

for air-transport operations, being capable of carrying a crew of two and ten passengers or wounded men in medium-range operation. A large volume of cabin space is available at the center of gravity of the machine. The craft can be trimmed through a wide range of load positions while in flight. It can land in a 100-ft. diameter clearing. This characteristic makes it suitable for picking up wounded personnel from inaccessible areas on land or water. Equipped with either an internal or external hoist, it can perform rescues without landing—that is, while hovering in the air.

Designated model PV-3 by the manufacturer, it is larger than other helicopters built to date, particularly its predecessor, the PV-2, which was the world's smallest when introduced almost 3 years ago. The Continental-Wright R-975 engine is completely enclosed aft of the cabin in the streamlined fuselage, 48 ft. long and 13 ft. high. The two rotors are placed in tandem, this application being described as the first to use that configuration.

In addition to the military models, the manufacturer is planning on producing a commercial version of this machine in the immediate future. Plans also call for the production of the single place PV-2 helicopter, with a two-place version to follow shortly. P-V Engineering Forum, Inc., Philadelphia.

Collet Chuck of 3 1/2 in. Capacity

Model No. 4 is the new unit of a line of collet air chucks. Having a collet capacity of 3 1/2 in., this chuck uses a special type 3 1/2 in. master collet. Various sizes of pads can be obtained to reduce the hole diameter to the desired size.

The No. 4 chuck allows work up to 3 1/2 in. to be held to the desired depth, since the parts can drop through the entire depth of the chuck. It is based upon the principle of the collet remaining stationary, while the opening and closing is controlled even though there are variations in the diameter of the work to be held, since there is no up or down movement of the collet. Redmer Air Devices Corporation, Chicago.

New British Aircraft

The Short Sandringham for air lines is a new flying-boat air liner which promises to play an important part in the postwar development of Great Britain's Empire routes. The new aircraft is already in production at the Rochester works of the company.

This four-engined civil flying boat does not differ in structure from the civil version of the Sunderland III, which has served on the routes from England to India. It is not a reconversion to the Empire flying boat but is a civil version of the military Sunderland which rendered war service with Coastal Command.

The modifications that make the Sandringham different from the Sunderland III are confined to secondary structural changes and to the complete rearrangement of the interior and associated equipment. It is designed to carry 24 passengers by day or 16 by night, in addition to mail and freight. The bow and tail have been redesigned and are completely changed from the military version.

Although the Sandringham is slightly smaller than the Empire (S.23) class, the span being 112.8 ft. compared with 114 ft. and the length being 85.3 ft. compared with 88 ft., it can carry a larger crew and more passengers, by virtue of its greater depth of hull. The crew of seven has two pilots, a navigator, radio officer, engineer, purser, and steward.

Passenger accommodation is increased over the older type by the installation of a dining saloon on the upper deck. This provides comfortable seating for eight persons, and the seats can be converted into four bunks for night travel. The three cabins on the lower deck seat 16 passengers, and the chairs can be quickly converted into 12 sleeping bunks. On the upper deck there is a buffet, equipped with refrigerator and steam oven, and a snack bar.

The Sandringham is powered by four Bristol Pegasus 38 air-cooled radial engines, each developing 1,030 hp. at take-off. Its weight, less pay load, is 45,380 lbs. and the pay load is 7,600 lbs., giving a loaded weight of 52,980 lbs. Its maximum permissible gross weight is 56,000 lbs.

At that weight, the flying-boat's cruising speed at 4,750 ft. is 199 m.p.h., and its range is 1,578 miles. Taking the same weight, the speed of take-off is 93 m.p.h. and the time is 56 sec. Its "service" ceiling is 14,150 ft., and normal climb power, with four engines, at sea level, is 557 ft. per min.

Newly released details reveal the Gloster Meteor—Great Britain's first operational jet-propelled fighter—as a twin-engined, low-wing, all-metal monoplane with a nose-wheel undercarriage. An unusual feature is the high-set split tailplane, made necessary in order to give ample clearance for the jets from the gas-turbine engines.

In other respects, the design follows conventional practice. The two halves of the elevators and the lower part of the rudder are fitted with trimming tabs operated by normal-type handwheels. The three legs of the undercarriage use hydraulic power for retraction and extraction, the two main legs folding inwards and being housed in wells between the engines and the fuselage. The nose wheel retracts rearwards and comes to rest in a housing between the rudder pedals. A camera gun mounted in the fuselage nose fairing is linked with the four 20-mm. cannon, which constitute the Meteor's armament, but can also be used independently of the cannon.

Measurements are given as: span, 43 ft.; length, 41 ft.; height, 13 ft.; wing area, 374 sq.ft. No hint of the Meteor's speed was given, and the only reference to performance was the statement that the aircraft "is very maneuverable and the landing speed is not high." The absence of vibration and noise in the cockpit during flight was noted.

The Meteor first flew in 1943 and was used against flying bombs in 1944. Later it was reported to be operating with the Second Tactical Air Force on the Continent.

Handley Page has released details of the latest type of Halifax bomber, successor to the Halifax Mark III. The Mark VI has the same wing span as the later version of the Mark III, 104 ft., but has a superior performance in every way.

Although the external appearance of these two aircraft is similar, with the same armament consisting of a single Vickers gun in the nose and two four-gun turrets in the mid-upper and tail positions, respectively, the Mark VI is powered by Bristol Hercules 100 engines, giving 1,800 hp. in place of the Bristol Hercules XVI giving 1,650 hp. With the additional power available, it has been possible to increase the load weight to 68,000 lbs., besides obtaining better take-off, higher cruising speeds, and a higher ceiling.

With these new high-altitude engines, the ceiling of the Halifax VI has been considerably increased. Maximum true air speed is 328 m.p.h., showing improvement over its predecessor, the Mark III. Maximum bomb load is 14,500 lbs. and maximum range is approximately 3,000 miles. The Society of British Aircraft Constructors, Ltd.

V-Belt 9-In. Lathe

A V-belt drive 9-in. precision bench lathe features four-step, V-belt cone pulleys. These, together with the back gears, provide either 8 or 16 spindle speeds, ranging from 46 to 1,176 r.p.m. The lathe is made with either quick-change gear or plain change gear equipment for a wide range of thread cutting and power longitudinal feeds. Two of the models incorporate power cross-feeds.

All models have a 9 1/4-in. swing over the bed and saddle wings and 3/4-in. headstock spindle hole with maximum collet capacity of 1/2 in. Choice of bed lengths gives maximum distances between centers up to 34 in.

This lathe is recommended by the maker for precision toolroom or production work and for general use in machine, laboratory, and repair shops for machining metals, plastics, compositions, and other machinable materials. South Bend Lathe Works, South Bend, Ind.

High-Octane Safety Aviation Fuel

High-octane safety fuel for use in aircraft engines was demonstrated recently by technicians of Standard Oil Company (New Jersey) and Pan American World Airways. The new safety fuel provides a safety factor that, engineers state, will increase utilization of commercial aircraft by making refueling in the air practical for long-range operation. The fuel is reported to give all the power of 100-octane gasoline but is so resistant to

accidental ignition that a lighted match can be dropped into it without causing a fire. The fuel must be heated to more than 100°F. to produce enough vapors to ignite, tending to eliminate the dangers of flash fire from fast-vaporizing gasoline that might be set off by a spark.

The practicability of the fuel was proved in recent running tests that the Wright Aeronautical Corporation conducted for Pan American at the Wright plant in Paterson, N.J., in a high-powered engine similar to those to be used by Pan American in the Clippers. These tests indicated that on every score safety fuel delivered the same horsepower as the high-octane gasoline in present use. The new fuel must be fed by direct injection rather than by ordinary carburetion, and it will be necessary to convert the engines of postwar Clippers for fuel injection when safety fuel is put into use unless suitable carburetors are developed. It was explained that after the fuel is injected in the cylinder it is vaporized by heat developed during compression. The fuel mixture is fired by the conventional spark plug.

During its development a type of the new fuel has been used to test fuel-pipeline systems on aircraft carriers. Its safer qualities have made it suitable for actual circulation tests while carriers were being built or repaired, without the danger of flash fires from the sparks of a welder's torch or static electricity. Safety fuel that has remained in the carriers' gasoline pipeline systems has blended satisfactorily with conventional gasoline. Standard Oil Company (N.J.).

Coolant and Cutting-Oil Strainer for Machine-Tool Applications

A nonclogging coolant and cutting-oil strainer for installation on grinders, lathes, and other machine tools is said to provide cleaner fluids and longer periods of uninterrupted strainer service. Known as Metax Model G, the strainer is constructed of knitted fabric and wire made into strong, noncollapsible rectangular units with high strainage area. The composite honeycomb mesh is fine enough to catch dirt, grit, and chips, while providing ample free area for the passage of cleaned fluids.

Designed for installation submerged in the machine-tool sump tank or in a separate tank on the pump intake, Model G is available in six sizes, surface straining areas, and capacities. They are made with three or six individual straining elements that are interchangeable as to length. Clean strainer refills can be installed in the slots, while the old ones are washed out for another long period of service. Strainer Products Corporation, Montclair, N.J.

"Three-Way" Bench Furnace

Designed to fulfill the requirements of a wide variety of applications, a new "three-way" bench-type Universal laboratory furnace is now available. Controlled operation over a wide range of temperatures further enlarges its field of use.

The furnace combines three different types of furnaces in one casing. It may be used as a direct-fired oven unit at temperatures from 300° to 2,400°F. For direct heating a muffle can be placed on the hearth. If an atmosphere is desired a diamond block can be used in the muffle. A removable plug built into the arch of the furnace provides a means of inserting a pot.

This laboratory furnace is suitable for small shops or laboratories where a wide variety of heat-treatments in relatively small quantities of small parts must be performed. Such operations as annealing, carburizing, hardening, cyaniding, and tempering, with or without a furnace atmosphere, can be handled by the one furnace. It functions as a direct-fired oven, indirect heated muffle, gaseous atmosphere, salt or lead bath type, and may also be used for melting soft and light metals, such as tin, lead, aluminum, magnesium, etc.

The furnace is equipped with three atmosphere-type gas burners, each of which can be independently controlled. The burners are arranged under the hearth to provide uniform and rapid heating throughout the heating chamber. A gas pressure regulator assures uniform control of burner operation. Fuel under low pressure without air under pressure is sufficient for burner operation, such as manufactured or natural gas at 3- to 6-in. water pressure, or butane or propane at 9- to 11-in. pressure.

To assure economical application where all the features of the unit are not desired, the muffle and certain other equipment are offered as accessories. Temperature indicators are in this category and are available if desired.

Dimensions are as follows: hearth width and length, 6 by 12 in.; door width and height, $5^1/_4$ by $4^1/_4$ in.; overall dimensions, width $19^1/_2$ in.; length $21^5/_8$ in.; height 29 in. Hours to heat from cold to 2,400°F., 2; maximum gas demand 90,000 B.t.u. per hour. The unit is designated as Universal Laboratory Furnace UL-6-12. Surface Combustion Corporation, Toledo, Ohio.

Use of Plastics in Rockets

Cellulose acetate plastics are playing an important role in the Navy's extensive rocket program for igniter cases, web inhibitors, and end inhibitors. Igniter cases are loaded with an explosive black powder that is ignited by the electrical firing system. The flash is transmitted to a propulsion charge of ballistite.

Several web inhibitors, approximately 1 in. wide and varying in length, are cemented on the four outer sides of the ballistite charge, which is cruciform in cross section. End inhibitors, also made in the form of a cross, are placed at either end of the charge. Since cellulose acetate burns slowly, these inhibitors serve to control the burning rate of the ballistite and, in effect, regulate the propulsion of the rocket.

The firing of the propulsion charge lasts about 1 sec. The burning of the ballistite within the rocket creates a pressure of approximately 2,000 to 3,000 lbs. per sq.in. and a temperature of about 3,000°F. Under intense heat, the cellulose acetate parts are not completely consumed, but remain a charred mass in the rocket. Gas from the burning ballistite is dissipated through the restricted nozzle orifice at the tail to propel the rocket. Some Navy rockets attain a velocity of 1,300 ft. per sec. while many are designed to travel at a slower rate.

Both the plastic igniter cases and the end inhibitors are produced by injection-molding, an automatic process whereby quantities of finished parts are produced in the shortest possible time. The material, heated to a plastic state, is injected under pressure into unheated mold cavities, where it hardens almost instantly. No finishing operations are necessary.

The web inhibitors are extruded in continuous lengths. By this method, the plastic is forced through a die of the cross-section shape desired. The material hardens upon cooling. The web inhibitors are slightly curved in cross section to conform to the outer surface of the ballistite charge.

Two types of rockets in which cellulose acetate plastic is used have 5-in. war heads containing T.N.T. One 5-in. Navy rocket is a high velocity aircraft rocket that was allocated to the Army for the Normandy break-through. Fire power of one plane equipped with eight of these rockets is reported to be equivalent to a salvo from a destroyer. Tennessee Eastman Corporation.

Ball Bushing for Reciprocating Mechanisms

Adaptable for round or square parts or various shapes, a new type of ball bushing permits unlimited travel of reciprocating mechanical members. The advantages gained from the use of ball bearings for rotating parts can thus be obtained on sliding members. (*See* page 151 for photograph.)

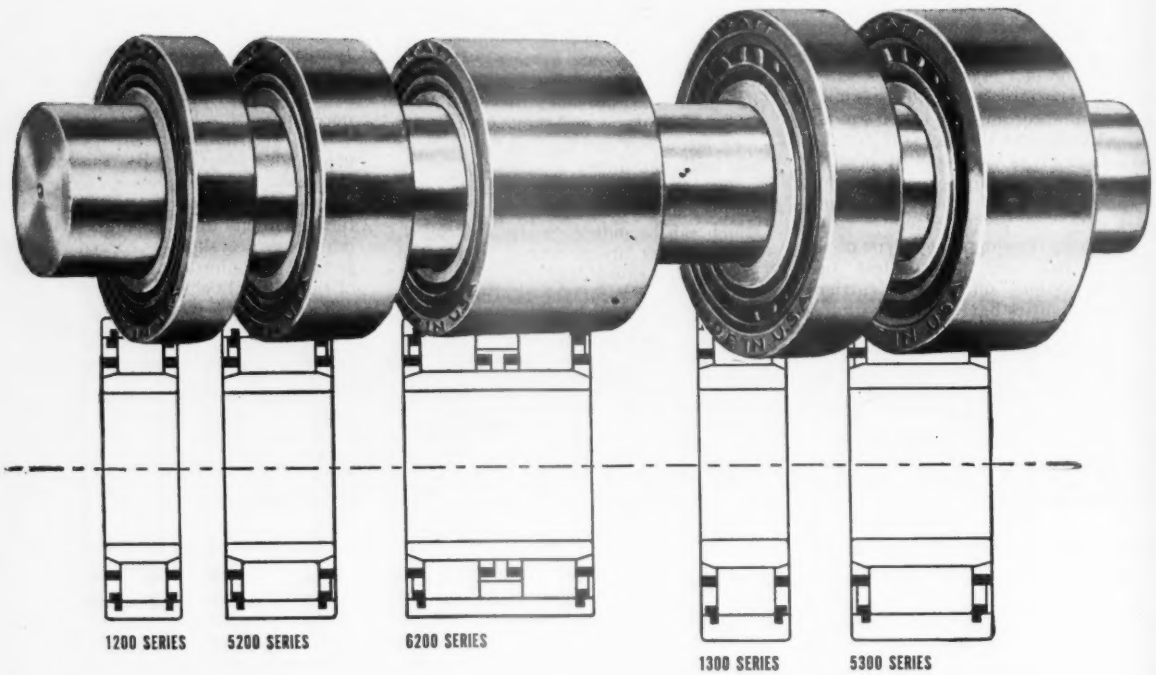
Basically, the ball bushing contains within it a series of ball circuits. One side of the circuit carries the bearing load, with the other side returning the balls in a clearance provided in the outer race member of the bushing. Free movement is obtained because of the reduction of friction. The continuous bearing prevents cocking or binding on the shaft because the bearing balls remain constantly centered under load. The rolling contact plus sealed-in lubrication results in an enduring, antifriction precision alignment.

The system of ball circuits can be infinitely varied for varying load capacities and shapes of bearing members. Thus it is possible to have a bearing of considerable length or of a square, hexagonal, or octagonal section. Results attributed to the use of ball bushings are reduction in the size, weight, and cost of machinery and equipment. Thrift-master Products Division of Thomson Industries, Inc., Long Island City, N.Y.

DESIGN ADVANTAGES

in overall size and capacity...

...BEARINGS: HYATT



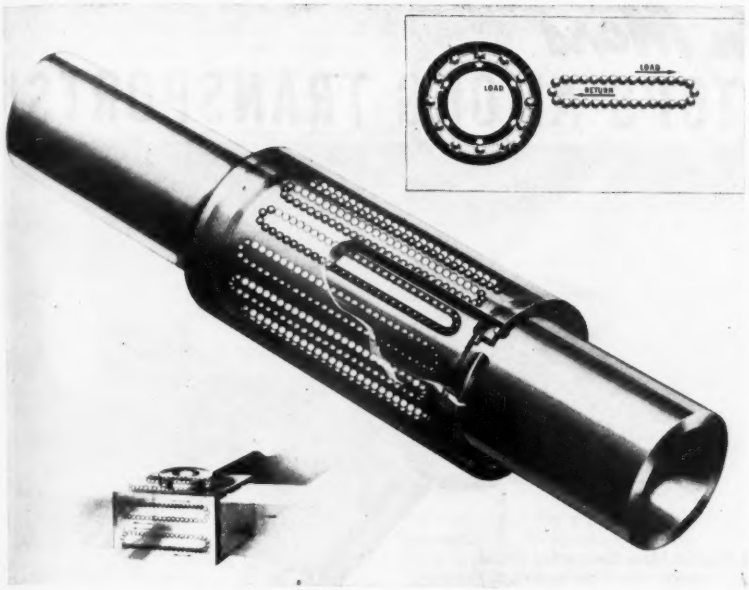
The design engineer who has a large selection of bearings to choose from, each differing in overall size and load-carrying capacity though fitting the same shaft, will find the task of designing greatly simplified.

If the load is light he may select the narrow width of the medium series—gaining in economy of cost, weight and space. If loads are heavy and the permissible outside diameter is limited, there are the wide and duplex widths of this same series. If loads are heavy and axial space is not available, the narrow and wide widths of the medium series provide increased capacity by increasing the annulus size.

These five combinations are available for most of the standard bearing bore sizes. All are manufactured from the same select materials and with the same precision to provide quiet, care-free operation. Ask for our Hy-Load Bearing Bulletin.

HYATT BEARINGS DIVISION • GENERAL MOTORS CORPORATION

Harrison, New Jersey • Chicago • Detroit • Pittsburgh • Oakland, California



The Thriftmaster ball bushing, for use in reciprocating mechanisms.

New Wind Tunnel

A wind-tunnel laboratory, capable of testing full-scale power-plant installations at air speeds of 200 m.p.h., as well as reduced-scale models of aircraft and propellers at air speeds of 600 m.p.h., has been added to the facilities of United Aircraft Corporation. Said to be the largest closed-circuit type ever to be constructed of reinforced concrete, the tunnel can test engines of up to 4,000 hp., equipped with propellers as large as 17 ft. in diameter. It was built especially for problems of power-plant testing.

Two alternate test sections, one with a throat diameter of 18 ft. and the other only 8 ft. in diameter, account for the tunnel's versatility and for the high air speeds available for scale-model testing. The volume of the 18-ft. tunnel, including the air exchanger, is nearly 500,000 cu.ft. The total length of the tunnel circuit is 634 ft. At its largest part, it is square in cross section and about 35 ft. in each dimension.

Auxiliary buildings at the wind-tunnel site were started early in November, 1942, and have been in use for some time. They include a two-story office building to house the technical personnel assigned to the wind tunnel and a large shop for the construction of test models. The shop has three main areas: a woodworking shop, a machine shop, and a metalworking shop equipped with a large drop hammer. In the rear of the office building there is a small "pilot" wind tunnel with a 4-ft. by 6-ft. test section for the quicker and cheaper preliminary testing of small models before larger ones are tested in the main wind tunnel at higher speeds.

The tunnel is of the closed-circuit type with four sides at right angles to each other, so that the flow of air is continuous around the 634-ft. tube. In one of the two longer sides is a 26-ft. diameter variable-pitch fan with 20 blades, driven by a 7,000-hp. electric motor. In the other longer side the two alternate test sections are installed. The larger of these is octagonal in shape and is 18 ft. across flats. Models can be supported in this 18-ft. test section in several ways. They can completely span the tunnel and be supported at the walls, or they can be held in position on either of two sets of struts. A turntable is provided so that models may be both yawed and pitched, making it possible to simulate all airflow conditions now being encountered by military aircraft. All mount supports are on a six-component balance frame that measures thrust up to 20,000 lbs. and has a lift capacity of 27,000 lbs. A large removable hatch on top of the section allows the use of a $7\frac{1}{2}$-ton crane for the rapid installation of models.

A feature of the tunnel is the smaller test section, which is also octagonal in cross section and measures 8 ft. from flat to flat. This is mounted on an arrangement of tracks and rails which makes it possible to wheel this smaller test section inside the fixed 18-ft. test section. A second movable section of the tunnel is then rolled into place to join the downwind end of the smaller test section with the remainder of the tunnel. With the 8-ft. test throat in place, air speeds of up to 600 m.p.h. are available to duplicate flight conditions now being approached by the fastest military aircraft. A complete change in test sections can be made in 6 hours. The same balance frame is used for both the 18-ft. and the 8-ft. test sections.

While the test sections, movable sections, and air-turning vanes are of steel, the main structure is reinforced concrete. To withstand a collapsing pressure of 800 lbs. per sq.ft., the concrete walls are $2\frac{1}{2}$ ft. thick in the balance-chamber area. The interior has received special treatment to prevent the concrete from flaking.

From the exterior, the most prominent portions of the tunnel structure are two air-exchanger towers, $66\frac{1}{2}$ ft. high. It is through these two towers, one on either side of the tunnel, that warm air is exhausted and fresh air inducted. Each tower is, in effect, two towers, one-half being used for the warm-air exhaust and the other for the fresh-air intake. Since the tunnel is designed to be operated at constant temperature, the quantity of fresh air admitted is determined thermostatically and controlled by the operation of two large movable valves, 34 ft. high. Up to 33 per cent of the air passing through the tunnel may be continuously exchanged.

Special equipment has been installed to provide power within aircraft models for driving model propellers, fans, and helicopter rotors. This power equipment consists of two independent 375-hp. variable-frequency sets to supply power to the electric motors in the models. With this equipment it is possible to operate as many as six electric motors at one time, at a total output of 750 hp., and to test a six-engine airplane model.

Also provided are two 375-hp. electric motors, 14 in. in diameter, for testing propellers approximately 4 ft. in diameter in either test throat to determine their aerodynamic characteristics. These motors were designed to turn dual-rotation propellers, the rear motor driving through the shaft of the front one. They can be operated together or separately. A special propeller test unit is under construction to support these motors in the tunnel and allow the propellers to be placed at various angles to the wind stream. Complete instrumentation has been provided for the measurement of the thrust, speed, and torque of the propellers. From the model power equipment, electric circuits are also connected to the 4- by 6-ft. "pilot" wind tunnel, so that it is possible to run model motors in it as well.

A movable outdoor test stand for engine nacelles consists of a heavy steel tube framework with an attached control house, all on wheels. The supporting system for the nacelle or model and the control and instrument leads are exactly the same as those used in the tunnel. This outdoor test stand enables considerable wind-tunnel installation time to be saved, since most operating "bugs" can be detected and corrected before installations are placed in the tunnel. United Aircraft Corporation.

Hot-Air Distribution System

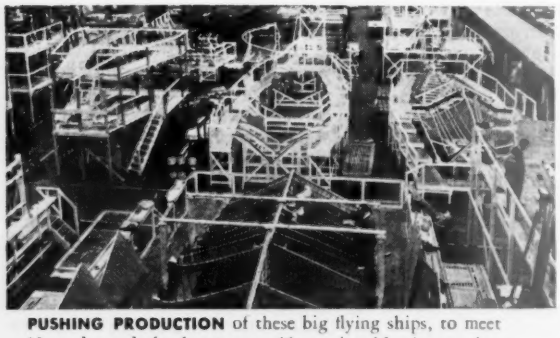
In order to combat the formation of ice on its surfaces, the C-82 Packet has a system of distributing hot air to all parts of the wings and to the tail assembly through nonmetallic ducts. Heated by the engine exhausts, the air is dissipated to the outer surfaces when the Packet is traveling at high velocity, raising the outside temperature to 130°.

WHY THE *Martin Mars* IS TOPS AMONG TRANSPORTS!

SKY GIANT! Martin Mars has carried useful loads of over 35,000 lbs. . . . flew 4,227 miles non-stop with 13,000 lbs. of cargo . . . operates at 15c per ton-mile. Her new sister-ships will operate at less than 10c.

BIG BOW of a JRM Mars gives idea of their vast size. Great 120-foot hulls contain 32 ports, 17 hatches, including the 8 by 7½ ft. cargo doors. Wing spread exceeds 200 ft.

WHY is the Martin Mars America's No. 1 transport plane? Let's look at the record! In her first 15 months of service the Mars carried 3,000,000 lbs. of cargo, nearly 2500 passengers, flew the equivalent of 10 times around the earth at the equator. During one month alone, she made 20 trips between Pearl Harbor and California for a utilization of 9.4 hours per day.



PUSHING PRODUCTION of these big flying ships, to meet Navy demands for fast transpacific service, Martin now has 70 manufacturers in 12 states turning out JRM sub-assemblies.

LUXURIOUS LOUNGE of postwar Mars. No cramped seats or narrow aisles here! Passengers will stroll about, visit bar, enjoy hot meals, sleep in private compartments.

NEW MARS TRANSPORTS

On the basis of this outstanding performance, the Naval Air Transport Service ordered a fleet of these highly efficient cargo carriers. Bigger, faster than the original Mars, these new transports will rush supplies to Pacific outposts at a rate of approximately 3000 ton-miles per hour . . . will operate at less than 10c per ton-mile . . . will be quickly convertible from cargo carriers to hospital ships accomodating 84 litter cases and 25 attendants or to transports seating 132 passengers. These huge 82-ton flying ships will soon be entering service.

COMMERCIAL VERSIONS

Commercial versions of the new Mars, offering great freight facilities and unsurpassed luxury to tomorrow's transocean travelers, are ready to build as soon as war conditions permit. With Martin plants tooled for and in quantity production of Mars flying ships, delivery of commercial models will be prompt.

THE GLENN L. MARTIN CO., BALTIMORE 3, MD.
THE GLENN L. MARTIN-NEBRASKA CO., OMAHA

Martin
AIRCRAFT
Builders of Dependable Aircraft Since 1909

The exhaust heat is piped directly from the plane's two 2,100-hp. engines into four cross-flow heat exchangers, two mounted in each engine nacelle. Air is brought in from the outside, heated in the exchangers to a temperature of 350°, then carried under pressure to all parts of the plane.

The ducts that carry the heat are made of fire-resistant glass fabric combined with synthetic rubber and resins. They are supplied in a wide variety of sizes and shapes to follow the contour of the plane's interior. United States Rubber Company.

Synthetic Rubber Hose Resistant to Heat and Pressure

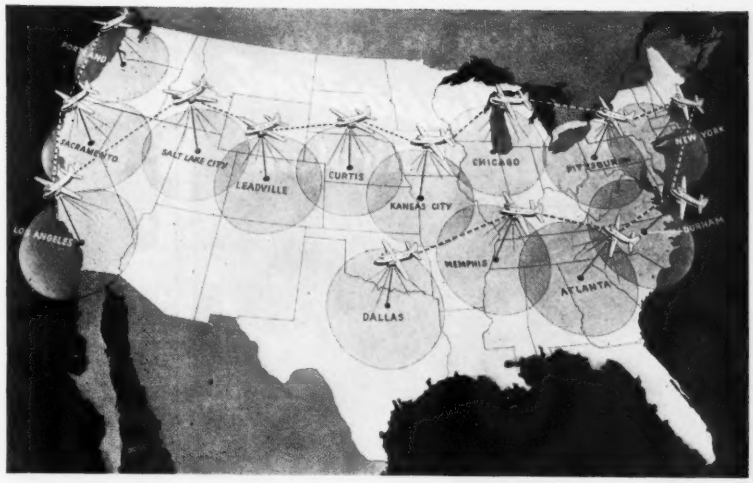
It is claimed that engines of American Army and Navy airplanes will be lubricated and cooled more efficiently as the result of a development of a new synthetic rubber hose that offers increased resistance to heat and pressure. The improved hose is designed to withstand temperatures up to 250°F. for use in oil lines and up to 300° for installation in cooling systems. Resistance to pressure in hose 1 in. in diameter is said to be double that of hose formerly used. The strength is increased proportionately in the other sizes, ranging from 1/4 in. to 2 1/2 in. in diameter.

Use of the hose reduces danger of engine trouble from faulty lubrication and cooling. Maintenance costs and man-hours are saved because replacement is required less frequently. One of the principal features of the hose's construction is the employment of a chemically treated cotton yarn much stronger than regular untreated cotton yarn. United States Rubber Company.

Air-Borne Television Broadcasts

Plans to inaugurate a new system of television and F.M. radio broadcasting from stratosphere airplanes cruising at an altitude of 6 miles, as soon as permits and equipment can be obtained, were announced by the Westinghouse Electric Corporation, in cooperation with The Glenn L. Martin Company. Initial flight tests of the system, known as Westinghouse Stratovision, are expected to be made this fall.

The Stratovision system is described as a means of placing the antenna and transmitter in an airplane flying in "lazy" circles 30,000 ft. above the earth, out of sight of human eyes. The short waves sent out from this air-borne antenna would blanket the earth's surface, covering a circular area 422 miles in diameter. Reception of Stratovision broadcasts would be practically free from interference and distortion caused normally by reflected ground waves and the numerous amplifications or relaying stages required by any previously proposed system to carry television and F.M. broadcasts over a comparable area. To provide a usable signal throughout a 422-mile-wide receiving area covered by a plane-borne transmitter at 30,000 ft. would require only one-fiftieth as much power as is needed by a 50-kw. transmitter on the ground covering an area only 100 miles in diameter, it is stated.



Photograph Courtesy Westinghouse Electric Corporation

Drawing showing the coverage of the projected air-borne television broadcasting system developed by Westinghouse Electric Corporation and The Glenn L. Martin Company. Each plane would receive and rebroadcast programs originating in studios on the ground and "beamed" to the transmitters mounted in the aircraft.

The Westinghouse Stratovision system would employ a low-powered ground transmitter to send television and F.M. broadcasts to the specially designed high-altitude plane. The plane would be equipped with receivers and transmitters for rebroadcasting these programs back to earth. As now conceived, the plan would employ four television and five F.M. transmitters on each plane. This combination, however, is predicated only on economy of operation and could be changed at will without altering technical aspects of the system.

A coast-to-coast network for relaying television and F.M. programs from plane to plane between New York and Hollywood would simply require stationing eight such stratosphere planes above strategic areas spanning the continent.

One of the most unusual features of the Stratovision system is its need for a "slow" airplane. Present plans call for conventional all-metal, low-wing monoplanes, almost as large as the B-29 but with gross weight only a third of that of the Superfortress. They would have automatic pilots, turbo-superchargers, and supercharged cabins. Each plane would have a wing spread of 161 ft. and weigh about 20 tons fully loaded. It would be powered by two 1,450-hp. engines, cruise at less than 150 m.p.h., have a top speed of 266 m.p.h. and be equipped with retractable landing gears. In addition to its nine transmitters and monitoring and relaying equipment, each plane would afford galley space and a lounge for the flight crew of three and six radio technicians. It would require only 25 min. for a fully loaded plane to attain the 6-mile broadcast altitude.

Each plane would carry the most modern instrument-flying and heat anti-icing equipment to insure safe ascent and descent through bad weather at lower altitudes. Planes would be designed to operate at the 30,000-ft. level for slightly under 11 hours on one fueling. Reserve endurance at that altitude would be provided for approximately 2 hours more so that maximum time aloft would be about 13 hours. Since operating schedules are planned on an 8-hour basis, this means that each plane would have more than 50 per cent reserve endurance, thus insuring continuous program service.

In addition to its four high-altitude planes, each broadcast location would have a smaller plane equipped to act as a flying remote-pickup unit. This plane would be available to cover any special event or emergency within the 103,000-sq.mile area, relaying television and F.M. programs to the parent plane for local broadcast or for nationwide network presentation. Westinghouse Electric Corporation.

Spray-Booth Lighting

Lighting a spray booth involves three fundamental problems: (1) to make a fire-safe installation; (2) to provide adequate lighting; (3) to make servicing easy and to minimize the cleaning problem.

In recent years lighting engineers have worked extensively with the spray-booth manufacturers in an effort to solve these problems with practical equipment and at minimum cost. If white is applied over a dark surface, 10 to 20 foot-candles of illumination is satisfactory. If a dark finish is applied over a dark surface, at least 50 foot-candles of illumination is required to give sufficient contrast between the finished and unfinished areas. However, most booths must be satisfactory for both high- and low-contrast painting, so the higher level is recommended. All harsh shadows should be eliminated

From Creation to Cargo *Weight's Important* in Airplanes

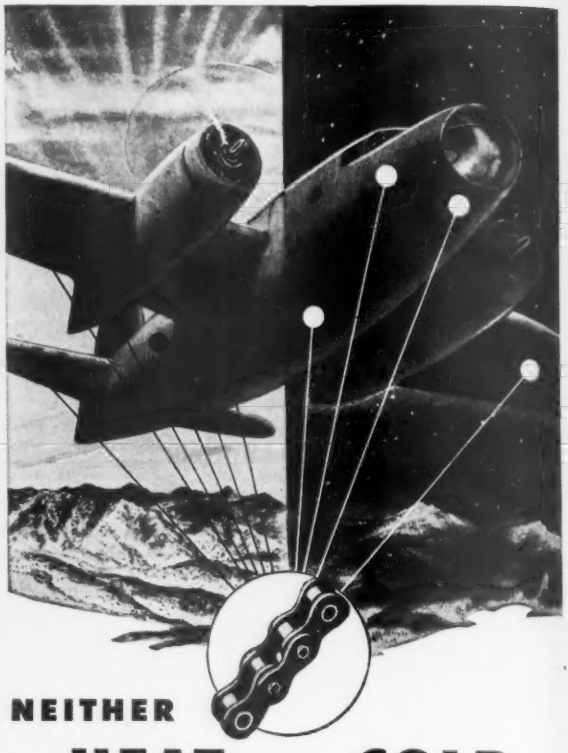
Here are two shots of a Douglas C-54 Combat Transport getting a weight check on a Fairbanks-Morse Crane Scale and two Aircraft Scales.

THE weights of the parts that go into a plane, the amount of fuel it carries, the weight of its passengers, crew, or cargo, are very big factors in performance. Therefore accuracy is a prime essential in any scale used.

And that's why Fairbanks-Morse Scales are so widely used in the aeronautical industry. They have a long-standing reputation for lasting accuracy, featherweight responsiveness. They're precision engineered to do any job from checking weight distribution to weigh-counting small but vital parts. A Fairbanks-Morse engineer will be glad to work with you in adapting them to your problems. Write Fairbanks, Morse & Co., Fairbanks-Morse Bldg., Chicago 5, Illinois.

Fairbanks-Morse
A name worth remembering

Diesel Locomotives • Diesel Engines • Generators
Motors • Pumps • Scales • Magnetos • Stokers
Railroad Motor Cars and Standpipes • Farm Equipment



NEITHER HEAT NOR COLD

. . . nor atmospheric pressure changes can stop Baldwin Roller chain belts from performing their appointed duties. These dependable chains are impervious to temperature and pressure. They respond instantly to the demands of the crew . . . govern and control with unfailing accuracy such important control points as:

Ailerons	Nose Wheel Doors
Wing Flaps	Sliding Hood
Rudders	Automatic Flight Control
Elevators	Arresting Hook
Bomb Bay Doors	Retractable Landing Gear
Tail Wheel Doors	Control Column

The high strength to low weight ratio, absence of "jerking" or "freezing" and great shock absorbing ability of Baldwin Roller chain belts and terminals are responsible for their preference among leading manufacturers for as many as 39 important control points.

For complete information on smooth Baldwin Roller chains and terminals and valuable information on airplane chain selection and arrangement, write for your copy of Engineering Handbook No. 67, Baldwin-Duckworth Division of Chain Belt Company, 355 Plainfield Street, Springfield 2, Mass.

BALDWIN
ROLLER CHAIN BELTS FOR AVIATION . . .

by properly locating and directing the luminaires. Fluorescent units are preferred for this purpose.

Fluorescent lighting has become the predominating type demanded for spray booth for four principal reasons: high foot-candles can be obtained at minimum wattage, minimum radiant heat improves worker's comfort, the long source of light minimizes shadows, and low brightness cuts down direct and reflected glare.

For spray booths, vaportight luminaires should be specified with a heat-tempered 1/4-in. thick glass cover. Either two or three 40-watt lamp units can be used, but the latter is recommended for most cases so as to obtain maximum illumination with a minimum number of units. Westinghouse Electric Corporation.

Valve-Facing Alloy for Higher Temperatures

A new valve-facing alloy for operation under high temperatures in high-output, heavy-duty, internal-combustion engines, is called "Eatonite." It was developed to meet problems encountered in engines designed to use high-test antiknock fuels.

Chief characteristics sought in development of the alloy were the corrosion-resistance of certain valve steels, together with the ability of tool alloys used for valve-facing to retain shape and hardness at high temperatures. It is claimed that the new alloy resists corrosion as well as or better than steels, and resists wear and deformation better than tool alloys.

Eatonite is an alloy containing nickel, chrome, cobalt, and tungsten, and in tests combined the qualities of "80-20" (valve metal containing approximately 80 per cent nickel and 20 per cent chrome) with the ability of tool alloy to retain shape and hardness under temperatures above 1,000°F. Wilcox-Rich Division, Eaton Manufacturing Company, Detroit.

New Bell-Jar Test Chamber Duplicates High-Altitude Conditions for Engine Study

The transparent bell jar, or dome, forming a part of a new high-altitude ignition-system tester, permits close observation of engine tests under high-altitude conditions. The equipment makes possible the simulation of a segment of stratosphere within the dome, duplicating the altitude conditions of cold and low atmospheric pressures that prevail at great heights. It can also simulate weather conditions such as fog, rain, desert heat, and ice, and the atmospheric changes encountered by a plane that climbs or dives rapidly.

Tests that hitherto were possible only in bulky pressure chambers that require additional instrumentation are now easily accomplished by the new device.

Two sources of troubles with aircraft ignition systems are corona and flash-over. Corona, observable as a faint violet light, forms around those parts of the ignition system that are under high electrical stress. It is evidence of electrical leakage and does exercise a detrimental effect on ignition performance. Flashover, a disability that permits the electrical energy to spark to ground instead of delivering it to the spark-plug gap, may result from moisture or a punctured ignition cable. The tester, by providing weather conditions that are productive of ignition ills, permits a close study that results in much valuable data for the field personnel.

The aim of the designer was to achieve a controlled duplication of the varying atmospheric conditions under which aircraft ignition systems must function efficiently. This indicated that the tester must be equipped with an air-tight chamber (the dome) from which air could be evacuated by a vacuum pump to achieve any given pressure and density within the chamber. A refrigerating device to transfer heat from the interior of the dome was needed to simulate the cold of the upper atmosphere.

The equipment to supply those effects was designed to be mounted either on or adjacent to the platform that would support the dome and the ignition system to be tested.

The removable Plexiglas dome serves the same purpose as a laboratory bell jar. It is of special design and construction, since commercial bell jars of this size are not available. The dome was built by the Rohm & Haas Company from the basic design submitted by Wright Aeronautical Corporation. Its weight, 350 lbs., is sufficient to furnish a good air seal when the dome is resting on the rubber gasket that rims the edge of the platform. It is easily removed from the platform by using a hoist.

Provisions are made within the dome for mounting a Cyclone 18 ignition harness, but any radial ignition system may be mounted for test with equal facility. The harness is mounted in substantially the same position it would occupy when installed on an actual engine. In order that the firing of the spark plugs may be observed, each is set into a spark-plug bomb.

The bombs are set up on the extremities of a spoke-like arrangement of nine arms which stem from a central hub. Each bomb is designed to carry four plugs, and the sparking action is observable through windows in the bombs.

It is impractical to provide the hot gases and fuel mixtures that are formed in the cylinder of an operating Cyclone 18, but equivalent electrical conditions are afforded by maintaining gas pressure in the bombs with carbon dioxide valved from a tank at one side of the tester.

The tester is calibrated for specific engine operating points in terms of carbon-dioxide gas pressures and engine speeds. To accommodate ignition systems of the supercharged type, air is supplied by an electric pump that can draw it from within the dome or from the outside atmosphere. This pressurizing air, from either source, must pass through a chemical drier that removes the moisture from it.

Power is derived from an electric motor to actuate the ignition system's component parts. An accurate check on the progress of the ignition cycle can be made from the timing disc, which has an indicator moving at half engine speed.

This gear reduction enables the indicator to revolve once for each of the two engine revolutions required to complete one engine cycle, and permits ready reading and recording.

In building the evacuation unit that develops the high-altitude atmosphere within the dome, the designer selected a standard aircraft vacuum pump. The pump is encased in a sheet-metal jacket that permits circulating cooling water. In action, the pump gives off a slight amount of oil vapor and this is exhausted through a pipe leading to the outside of the building. Running at high speed the evacuation system can simulate quickly the pressure and air density found at altitudes up to 63,000 ft.

Actuation and control of many of the functions of the ignition-system tester are centered at the instrument panel. Control switches on this board govern the operation of the magnetos, fan, vacuum pump, heater, carbon-dioxide valving, and the refrigeration equipment.

Also mounted on this panel are the instruments used by the service technicians to assay the test conditions. Occupying an important position in the group of instruments is a single-column, well-type mercury manometer that records the pressure within the dome. The manometer has two scales. One side of the mercury column is calibrated in thousands of feet up to 80,000 ft. The other scale, on the opposite side of the column, is calibrated in inches of mercury absolute. These scales are adjustable to compensate for initial normal altitude and barometric pressure at the location of the tester.

Other measuring instruments are an altimeter with a compensating scale for barometric pressure, and an electric tachometer driven by the accessory drive which has a range from zero to 3,000 r.p.m. and is calibrated in engine speed.

There is also a gage used to measure the pressure of the air required for supercharging the ignition harness. This permits evaluation of the phases of supercharging. Pressures within the spark-plug bombs are recorded by a gage located to the left of the panel.

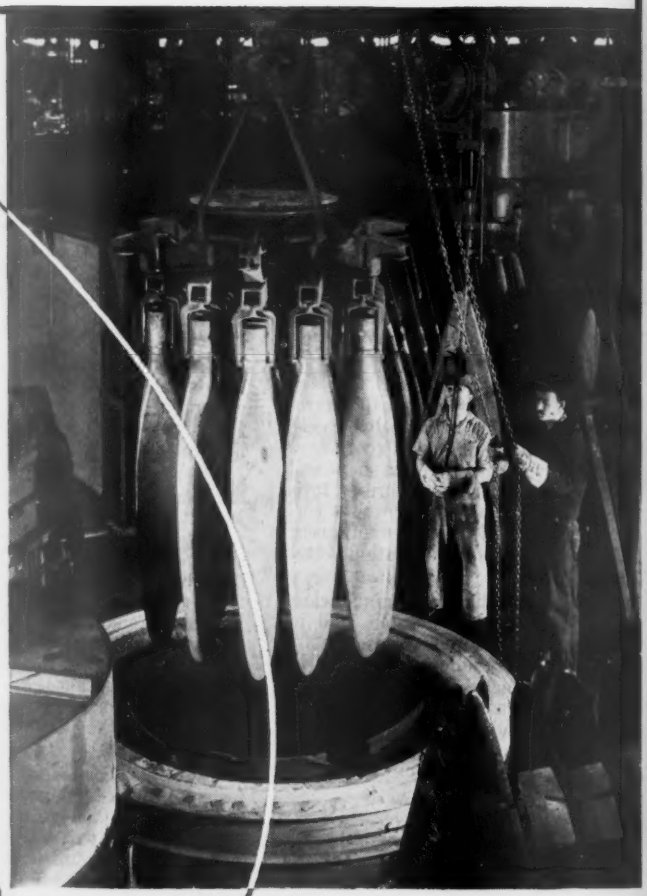
These instruments make it possible to adjust the tester to the desired conditions. Wright Aeronautical Corporation.

NICKEL STEELS combine . . .

EXCEPTIONAL MECHANICAL *and* FABRICATING PROPERTIES

SAE 4330 Nickel chromium molybdenum alloy steel was adopted for Curtiss propeller blades because of its high strength, toughness and good workability, coupled with a wide safe heat-treating range.

High velocity cooling is not necessary to properly harden SAE 4330 for this application. There is no warping to correct by cold-straightening operations nor danger from subsequent stresses that might cause failure in service, because the slow transformation rate of this steel permits hardening to the required degree by die-quenching; thus consequent savings in time and labor, and a uniform final product are provided.



Curtiss Propeller Division of Curtiss-Wright Corporation, one of the largest producers of constant speed propellers, fabricates blades by welding two plates of SAE 4330 into a hollow unit that permits weight saving over solid blades of light metals.

Inquiries on the use of Nickel alloy steels or other alloys containing Nickel in your products or equipment, are invited.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.